

USAFSAM-TR-89-4

AD-A210 413

**A TRISERVICE COMPARISON OF  
DENTAL SCALING DEVICES:  
SONIC AND ULTRASONIC**

Joe B. Drane III, Lieutenant Colonel, USAF, DC  
Bruce A. Matis, Colonel, USAF, DC  
David W. Sexson, Master Sergeant, USAF

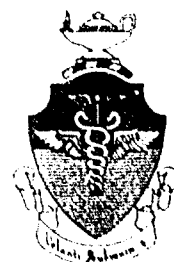
May 1989

**DTIC**  
**ELECTE**  
**JUL 21 1989**  
**S D D**

Final Report for Period January 1988 - January 1989

Approved for public release; distribution is unlimited.

USAF SCHOOL OF AEROSPACE MEDICINE  
Human Systems Division (AFSC)  
Brooks Air Force Base, TX 78235-5301



## NOTICES

This final report was submitted by personnel of the Dental Investigation Service, Clinical Sciences Division, USAF School of Aerospace Medicine, Human Systems Division, AFSC, Brooks Air Force Base, Texas, under job order NGDATRPR.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, or any agency, contractor, or subcontractor thereof. The views and opinions of the authors expressed herein do not necessarily state or reflect those of the United States Government or any agency, contractor or subcontractor thereof.

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.



JOE B. DRANE III, Lt Col, USAF, DC  
Project Scientist



PAUL R. PARK, Colonel, USAF, DC  
Supervisor



GEORGE E. SCHWENDER, Colonel, USAF, MC, SFS  
Commander

## REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

<b>1a. REPORT SECURITY CLASSIFICATION</b> Unclassified			<b>1b. RESTRICTIVE MARKINGS</b>										
<b>2a. SECURITY CLASSIFICATION AUTHORITY</b>			<b>3. DISTRIBUTION/AVAILABILITY OF REPORT</b> Approved for public release; distribution is unlimited.										
<b>2b. DECLASSIFICATION/DOWNGRADING SCHEDULE</b>													
<b>4. PERFORMING ORGANIZATION REPORT NUMBER(S)</b> USAFSAM-TR-89-4			<b>5. MONITORING ORGANIZATION REPORT NUMBER(S)</b>										
<b>6a. NAME OF PERFORMING ORGANIZATION</b> USAF School of Aerospace Medicine		<b>6b. OFFICE SYMBOL (if applicable)</b> USAFSAM/NGD	<b>7a. NAME OF MONITORING ORGANIZATION</b>										
<b>6c. ADDRESS (City, State, and ZIP Code)</b> Human Systems Division (AFSC) Brooks Air Force Base, TX 78235-5301			<b>7b. ADDRESS (City, State, and ZIP Code)</b>										
<b>8a. NAME OF FUNDING/SPONSORING ORGANIZATION</b> USAF School of Aerospace Medicine		<b>8b. OFFICE SYMBOL (if applicable)</b> USAFSAM/NGD	<b>9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER</b>										
<b>8c. ADDRESS (City, State, and ZIP Code)</b> Human Systems Division (AFSC) Brooks Air Force Base, TX 78235-5301			<b>10. SOURCE OF FUNDING NUMBERS</b> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <th style="width: 25%;">PROGRAM ELEMENT NO.</th> <th style="width: 25%;">PROJECT NO.</th> <th style="width: 25%;">TASK NO.</th> <th style="width: 25%;">WORK UNIT ACCESSION NO.</th> </tr> <tr> <td style="text-align: center;">87714F</td> <td style="text-align: center;">NGDA</td> <td style="text-align: center;">TR</td> <td style="text-align: center;">PR</td> </tr> </table>			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.	87714F	NGDA	TR	PR
PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.										
87714F	NGDA	TR	PR										
<b>11. TITLE (Include Security Classification)</b> A Triservice Comparison of Dental Scaling Devices: Sonic and Ultrasonic													
<b>12. PERSONAL AUTHOR(S)</b> Drane, Joe B. III; Matis, Bruce A.; Sexson, David W.													
<b>13a. TYPE OF REPORT</b> Final		<b>13b. TIME COVERED</b> FROM 88/01 TO 89/01		<b>14. DATE OF REPORT (Year, Month, Day)</b> 1989, May	<b>15. PAGE COUNT</b> 54								
<b>16. SUPPLEMENTARY NOTATION</b>													
<b>17. COSATI CODES</b> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 33%;">FIELD</th> <th style="width: 33%;">GROUP</th> <th style="width: 33%;">SUB-GROUP</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">06</td> <td style="text-align: center;">12</td> <td></td> </tr> </tbody> </table>			FIELD	GROUP	SUB-GROUP	06	12		<b>18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)</b> Dental Equipment, Scaler Comparison Sonic Scaler, Piezoelectric Ultrasonic Scaler, Magnetostrictive				
FIELD	GROUP	SUB-GROUP											
06	12												
<b>19. ABSTRACT (Continue on reverse if necessary and identify by block number)</b> The purpose of this study by the USAF Dental Investigation Service was to evaluate 14 dental power scalers, including magnetostrictive and piezoelectric ultrasonic scalers as well as sonic scalers. The scalers were first measured and technically evaluated against locally developed standards. They were then mailed to Army, Navy, and Air Force dental clinics where they were clinically evaluated by periodontists, dental hygienists, and dental technicians. The evaluators' findings are presented in a format which should help facility-level department chiefs make decisions on which power scalers to purchase for their clinics' needs.													
<b>20. DISTRIBUTION/AVAILABILITY OF ABSTRACT</b> <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			<b>21. ABSTRACT SECURITY CLASSIFICATION</b> Unclassified										
<b>22a. NAME OF RESPONSIBLE INDIVIDUAL</b> Joe B. Drane III, Lt Col, USAF, DC			<b>22b. TELEPHONE (Include Area Code)</b> (512) 536-3502	<b>22c. OFFICE SYMBOL</b> USAFSAM/NGD									

# CONTENTS

	Page
INTRODUCTION.....	1
<b>PART I</b>	
HISTORY AND LITERATURE REVIEW.....	1
<b>PART II</b>	
TEST METHODS AND FINDINGS.....	5
RESULTS.....	9
ULTRASONIC SCALERS - MAGNETOSTRICTIVE	
Cranston Industries Inc., A/G 1050 .....	9
Dentsply Cavitron, 3000 .....	10
Engler Engineering Corp., Sonus V .....	12
Engler Engineering Corp., Ultrason 990 .....	14
Parkell, Le Clean Machine, D 550 .....	16
Simplified Systems Inc., Sonatron S3M .....	17
Simplified Systems Inc., Sonatron S3X .....	19
ULTRASONIC SCALERS - PIEZOELECTRIC	
Health Science Products, HSP Ultrasonic .....	20
Satelec, SP-Quick .....	22
Spartan USA, The Piezo-Electric .....	24
Young Dental Manufacturing, Ultra-Scaler 3100 .....	25
Young Dental Manufacturing, Ultra-Scaler 3200 .....	27
SONIC SCALERS	
Den-Tal-Ez, Star Titan-S.....	29
Kavo America, SONICflex 2000.....	31
<b>PART III</b>	
CONCLUSIONS .....	32
REFERENCES .....	34
APPENDIX A: SYNOPSIS OF DENTAL POWER SCALERS.....	37
APPENDIX B: SCALER EVALUATION SCORE SHEET.....	41
APPENDIX C: CLINICAL EVALUATIONS RAW DATA.....	43

List of Figures

Fig. No.		Page
1	Cranston Industries A/G 1050 .....	9
2	Dentsply International Cavitron 3000 .....	11
3	Engler Engineering Corp. Sonus V .....	12
4	Engler Engineering Corp. Ultrason 990 .....	14
5	Parkell Le Clean Machine .....	16
6	Simplified Systems Sonatron S3M .....	17
7	Simplified Systems Sonatron S3X .....	19
8	Health Science Products HSP Ultrasonic Scaler .....	21
9	Satelec SP-Quick .....	22
10	Spartan USA The Piezo-Electric .....	24
11	Young Dental Manufacturing Ultra-Scaler 3100 .....	26
12	Young Dental Manufacturing Ultra-Scaler 3200 .....	27
13	Den-Tal-Ez Star Titan-S .....	29
14	Kavo America SONICflex 2000 .....	31

List of Tables

Table No.		
1	Tri-Service Dental Scaler Study - Units Tested .....	5
2	Cranston Industries A/G 1050 Characteristics .....	9
3	Dentsply Cavitron 3000 Characteristics .....	11
4	Engler Sonus V Characteristics .....	13
5	Engler Ultrason 990 Characteristics .....	15
6	Parkell Le Clean Machine Characteristics .....	16
7	Simplified Systems Sonatron S3M Characteristics .....	18
8	Simplified Systems Sonatron S3X Characteristics .....	19
9	Health Science Products HSP Ultrasonic Characteristics .....	21
10	Satelec SP-Quick Characteristics .....	23
11	Spartan USA Piezo-Electric Characteristics .....	24
12	Young Dental Mfg. Ultra-Scaler 3100 Characteristics .....	26
13	Young Dental Mfg. Ultra-Scaler 3200 Characteristics .....	28
14	Den-Tal-Ez Star Titan-S Characteristics .....	30
15	Kavo America SONICflex 2000 Characteristics .....	31



Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

# A TRISERVICE COMPARISON OF DENTAL SCALING DEVICES: SONIC AND ULTRASONIC

## INTRODUCTION

The USAF Dental Investigation Service (DIS) regularly receives requests for advice concerning the purchase of dental scaling devices. Dentists want to know which units to buy. Scaler manufacturers' claims and counterclaims, combined with the bewildering number of instruments on the market today, can make that buying decision difficult.

This study was undertaken to technically measure and clinically evaluate various power scalers. It is the first Triservice study of its kind, gathering the impressions of users from the Army, the Navy, and the Air Force to help facility-level department chiefs make purchasing decisions concerning dental sonic and ultrasonic scalers.

The following report is divided into three parts. Part I is a review of the literature and contains a short history of the development of power scalers. It also contains a discussion of the relationship between dental scalers and cardiac pacemakers. Part II is divided into Section A, containing a description of the methods and materials used, and Section B, which contains test results. In Section B each scaler is described and evaluated, and has received a DIS recommendation. Part III contains conclusions drawn from the study. Appendix A is a synopsis of the scalers' "vital statistics." Appendix B contains the scaler evaluation sheet. It was used by the clinical evaluators to collect raw data about the scalers. Appendix C contains the compiled raw scores of the clinical trials.

## PART I: HISTORY AND LITERATURE REVIEW

### Background

In November 1952, featured on the cover of Life Magazine was a picture of a corkscrew penetrating a piece of glass (1). The significance of the picture was that it illustrated the use of vibratory action to cut through seemingly forbidding substances using a surface which vibrated in excess of 20,000 cycles per second (cps) or hertz (Hz) (2). The technique's name? Ultrasonics.

### Ultrasonics In Dentistry

Around the country dentists' imaginations were stirred. Here was a piece of glass (similar in hardness to a tooth), being penetrated by a piece of metal (similar to a dental bur). Many of those dentists wrote to suggest that the technique could be used to make a vibrating dental drill which could replace the rotary handpiece. Indeed, ultrasonic dental handpieces were developed and some 15,000 of them were sold (2). But another use also came to mind.

### The First Ultrasonic Scaler

Why not use such vibratory action to cleave calculus deposits from tooth surfaces? Cavitron Ultrasonics Inc., the creators of that first ultrasonic dental drill, answered by developing a small ultrasonic prophylaxis unit. It consisted of an electronic generator which pulsed energy at 25,000 Hz, a handpiece to transfer that energy to the tooth

surface, and a series of special inserts for use with the handpiece (2). The result was the first dental ultrasonic scaler. It was a phenomenal success as evidenced by the number and variety of scalers commercially available today.

Applying ultrasound to dental hand instruments coupled a level of power to gentleness and precision of control such as had never before been seen. In fact, there were numerous advantages to this new instrument for calculus removal, including decreased hand fatigue for the operator, decreased force required to clean the object, decreased need for ultrasharp edges on scalers, decreased "scraping" sensation to the patient, and possibly increased cleansing action from the cavitation phenomenon at the scaler tip.

### Decreased Need For Instrument Sharpness

In conventional hand-scaling techniques, instrument sharpness is paramount. Many operators won't use a set of scalers twice before resharpenering. The ultrasonic scaler reduces that need. No longer is a finely honed edge so important in the removal of calculus. In fact, a sharp edge may even be detrimental because it requires a finer touch to avoid scarring the tooth surface. Investigators found that a blunt tip, vibrating many thousands of cycles per second and applied lightly to hard calculus deposits attached to the side of the tooth, rapidly fatigued the calculus, breaking it down into tiny particles. The particles formed a slurry which, when excited by the ultrasonic cavitation effect at the scaler tip, further aided in site cleansing.

### Magnetostrictive Scaler Construction (Cavitron Style)

The original type of ultrasonic scaler is magnetostrictive, that is, it uses a "stack" of leaf-thin, nickel-iron plates, which undergo various, minute contortions when placed in a magnetic field. A coil of wire surrounding the stack of metal plates, which is itself surrounded by a plastic handle, makes up the handpiece. When charged with electricity the coil creates a magnetic field and causes the stack to alternately distort and return to its original shape. The stack is directly coupled to the scaler tip; as the stack vibrates, the scaler tip vibrates.

Additionally, the magnetostrictive mechanical action supplies heat during operation. The heat generated in the handpiece is absorbed by water; the water serves as a coolant for the handpiece, as warm lavage for the operative site, and as a medium for the cavitation process generated by the rapidly vibrating scaler tip.

The power unit, an electronic generator, provides current alternating in excess of 20,000 Hz. Since it exceeds the frequency range of the human ear (approximately 20 - 20,000 Hz), this high frequency is termed ultrasonic. The oscillation at the scaler tip is made possible by pulses of electricity which are converted in the handpiece to mechanical motion; the minute vibrations in the metal leaves of the scaler insert create a cavitation effect.

### Cavitation Effect

The cavitation effect associated with ultrasonic scaling may be another advantage to the technique. Cavitation is the almost instantaneous release of energy from collapsing air bubbles in a liquid. These bubbles collapse and release energy as the result of alternating pressures on the liquid they are suspended in. Most of us have seen cavitation in boiling water and near ships' propellers. When the intensity is high enough,

we can see this same cavitation phenomenon caused by ultrasound. High intensity, alternating pressure waves passing through water at the tip of the scaler force air bubbles in the liquid to rapidly expand and contract until they suddenly collapse, releasing energy in the form of heat. As these bubbles change size at the surface of the tooth, they help to dislodge debris which is washed away by the flowing water.

## Pacemakers and Ultrasonic Scalers

A disadvantage of the magnetostrictive scaler is its potential to cause electromagnetic interference (EMI) in cardiac pacemakers (3, 4). Pacemakers have been used since 1958; there are two types: fixed rate and demand. The fixed rate pacemakers are asynchronous; that is, they pulse at a given frequency. They are therefore not affected by EMI. On the other hand, the demand pacemaker units are designed to sense cardiac rhythm and pace the heart only in the absence of intrinsic electrical activity (5). Any device which produces a strong enough EMI can potentially interfere with demand pacemakers.

In fact, other electrical devices such as microwave ovens, electric shavers, electrocautery, diathermy, vitalometers, and even electric toothbrushes have the potential to cause EMI (5). Microwave ovens have, since their early "leaky" days, been improved through better shielding and are no longer considered a threat to the pacemaker patient. The other devices listed here, however, continue to cause concern.

In the case of the magnetostrictive ultrasonic scaler, when the operator activates the unit the resultant EMI could cause the pacemaker to "sense" cardiac activity and therefore cease its own pacing. In instances where the operator has the habit of "pulsing" the scaler during its operation, creating short bursts of intermittent power, long periods of asystole are possible. The threat of resultant seizures, dizziness, and serious cardiac events cannot therefore be overlooked.

## Risk to Pacemaker Wearers

Fortunately the chance of serious interference from dental ultrasonic scalers is minimal. A review of the literature reveals no serious incidents of pacemaker dysfunction as a result of the use of dental power scalers. Scherman and de Wet, commenting on a 1974 test by Meisel, Machtens, and Abbink, reported that, at a distance of 30 cm (12 in.) or more, none of the electrical equipment they tested affected pacemakers (5). In 1983 Adams and Beechy tested 11 ultrasonic scalers vs five demand pacemakers. They found that when the scaler handpieces were at least 6 cm (2.4 in.) from the pacemaker leads, none exhibited any interference (6). Covering the chest with a lead apron during treatment in an attempt to protect from EMI has had mixed results (5, 6).

Although a scaler-to-pacemaker lead distance of less than 6.4 cm (2.5 in.) may seem small, and therefore safe, the operator should keep in mind that pacemaker leads often run through the subclavian or external jugular vessel on their way to the heart ventricle. Therefore, even such a short distance is within the working range of the ultrasonic scaler handle during a normal dental prophylaxis and precautions cannot be relaxed in the case of the magnetostrictive ultrasonic scaler. Piezoelectric and sonic scalers, however, are free of this EMI hazard (6, 7).



## Piezoelectric Scaler Construction

In the early 1970s, a new technology in ultrasonic cleaning became available. The new concept replaced the nickle-iron stack of the magnetostrictive scaler with a crystal system which expanded and contracted when an electric current was applied. This phenomenon is known as the piezoelectric effect. It creates a reciprocal rather than an elliptical motion, and is reversible; i.e., a crystal that is mechanically deflected will produce electricity (piezoelectric cigarette lighters, photoflash cubes). The low EMI level emitted from this type of scaler is not hazardous to cardiac pacemakers. It is, therefore, a safe alternative to the magnetostrictive scalers (6, 7).

## Piezoelectric Versus Magnetostrictive Tip Motion

An additional advantage, suggested by one manufacturer, is that the reciprocal or "back-and-forth" motion of piezoelectric ultrasonic scalers is gentler to the tooth than the elliptical motion of magnetostrictive (Cavitron-style) ultrasonic scalers. This advantage is, as the manufacturer explained, due to its action parallel to the tooth surface, as opposed to the elliptical motion of the Cavitron-style scalers which can strike the tooth surface at an infinite number of angles within the 0-180 degree range, dependent upon where in the elliptical pattern the steel tip actually strikes the tooth surface. A review of the literature, however, fails to reveal clinical substantiation of such claims. In fact, the claim that the reciprocal motion is better because it is parallel to the tooth surface ignores the fact that the user's hand position determines the angle of the scaler tip. The reciprocal motion of the piezoelectrics does not, therefore, guarantee parallel action to the tooth surface.

## Advances in Magnetostrictive Ultrasonics

Today ultrasonic scalers are rapidly evolving to meet the needs of the dental profession. They are being adapted to simultaneously apply oral medicaments during tooth scaling (14, 15). Other multi-purpose units are being introduced which can remove surface stains with an abrasive powder as well as scale the teeth. Ultrasonic scalers are now available in the more powerful 40,000 Hz range, whereas the first scaler oscillated at 25,000 Hz (1).

## Sonic Scalers

Today, sonic scalers have joined the ultrasonic scalers on the scene. Having received good reviews as handy devices for minor scaling and crown and bridge cement removal, they are now competing favorably as general purpose scalers (8, 9). Sonic scalers are even undergoing expanded use in subgingival scaling and root planing (10-13).

Sonic scalers are the latest addition to the array of power scalers. They contain air-driven rotors, and have the advantage of being able to be plugged right in to the high-speed handpiece hose at the dental unit. Their small size and simple installation make them extremely portable. No power generator box, wall plug, or special water hookup is required. Only a high-speed handpiece attachment with water is required. However, in contrast to the ultrasonic scalers their oscillations are below 20,000 Hz, a fact which lends them their "sonic" designation. Like the piezoelectric ultrasonic scalers they are, due to their low EMI, not hazardous to use on the patient who wears a cardiac pacemaker.

## Sonic Scaler Tip Motion

The elliptical tip motion of the sonic scaler is similar to that of the magnetostrictive ultrasonic type (Cavitron style). Actually two ellipses are created; one is 60 degrees from the longitudinal plane while the other is along the transverse axis (16).

Clearly, the literature reveals that power scalers, both sonic and ultrasonic, have been time and effort savers. The literature does not, however, reveal users' studies where brands of scalers were compared. The single exception to this is a report by Clinical Research Associates (CRA) in which the Star Titan-S sonic and the Cavitron 2002 ultrasonic scalers were top-rated (17). The CRA report did not, however, describe the methods and materials used in arriving at their conclusions.

### PART II: A. TEST METHODS AND FINDINGS

#### Methods and Materials

Eleven manufacturers supplied 14 models of sonic and ultrasonic scalers (2 sonic and 12 ultrasonic), to the USAF Dental Investigation Service (DIS) for a two-phase study (Table 1). The two phases were: Phase 1, In-house Testing, and Phase 2: Clinical Evaluations.

TABLE 1. TRI-SERVICE DENTAL SCALER STUDY - UNITS TESTED

Model Name	Manufacturer	Type	DIS Recommendation
1. A/G 1050	Cranston Industries Inc.	magnetostrictive	acceptable
2. Cavitron 3000	Dentsply International	magnetostrictive	recommended
3. HSP Ultrasonic	Health Science Products	piezoelectric	acceptable
4. Le Clean Machine	Parkell	magnetostrictive	acceptable
5. Sonatron S3M	Simplified Systems Inc.	magnetostrictive	not recommended
6. Sonatron S3X	Simplified Systems Inc.	magnetostrictive	acceptable
7. SONICflex	Kavo America	sonic	recommended
8. Sonus V	Engler Engineering Corp.	magnetostrictive	recommended
9. SP-Quick	Satelec	piezoelectric	acceptable
10. Star Titan S	Den-Tal-Ez Inc.	sonic	recommended
11. The Piezoelectric S3	Spartan USA	piezoelectric	acceptable
12. Ultra-Scaler 3100	Young Dental Mfg.	piezoelectric	acceptable
13. Ultra-Scaler 3200	Young Dental Mfg.	piezoelectric	acceptable
14. Ultrason 990	Engler Engineering Corp.	magnetostrictive	recommended

## Recommendations Explained

As we evaluated the units in-house and interpreted the data from the clinical evaluators, we were able to rate the scalers "Recommended," meaning the scaler functioned very well in all critical aspects; "Acceptable," meaning the unit was average, neither highly touted nor found to be unacceptable by evaluators; "Not recommended," that is, rated below average overall but not a safety hazard to use; and "Unacceptable," meaning the unit was a safety hazard or of such low quality as to be of no value to military facilities. The recommendations for each of the units are listed as the last comment of each scalers' description found in Part II-B.

DIS evaluators developed testing protocols based on their perceptions of the expected needs of users in the clinical setting. These perceptions were based on the evaluators' own field experiences, questions from the field, and queries to the field and to scaler manufacturers asking them what features they would like to see tested in dental power scalers.

### PHASE 1: In-House Evaluation

In Phase 1 of the study, all units first received an objective in-house evaluation to determine their physical characteristics. The following criteria were developed by DIS evaluators to compare the units against selected criteria.

- Size in box: The boxes the scalers arrived in were measured to determine their cubic footage. This information can be an important factor if the unit is planned for a mobile dental operatory where space is limited.
- Gross weight of unit plus packing: Scaler packages were weighed prior to unpacking. The weight of the scaler package should be a consideration for combat support and mobility situations.
- Unit dimensions after unpacking: Knowing the "footprint" of the scaler can help determine if it will fit a preexisting space or if it will help justify the need for a given amount of countertop space.
- Minimum vertical space required for use: Some equipment items require "space to breathe," space beyond their actual vertical height.
- Weight of unit: Weight is an important piece of information in the event the scaler must be moved from operatory to operatory.
- Does the unit have non-skid feet on bottom? Skid resistance can be important, especially if the unit is to be placed on the dental unit bracket table over the patient.
- Are there separate, variable power and water controls? Separation of these controls is desirable to allow the operator to custom tailor the power/water ratio to help control patient sensitivity.
- Length of handpiece cord: Scalers vary considerably in this area. Length can dictate where the power generator unit can be stationed.

- Length of handpiece and scaler tip: The overall length of the working handpiece can affect how the scaler fits (its feel) the operator's hand.
- Weight of the handpiece plus cord: Weight can affect the feel of the handpiece.
- Length of foot pedal cord: Cord length can be a factor in whether or not the scaler power generator can be placed where it is needed in the dental operator.
- Does the foot pedal have a non-skid bottom surface? This is a desirable feature, affecting stability and smooth control of power to the handpiece.
- Electrical specifications: Power considerations are important in determining whether or not the scaler is going to work with the power source available in your clinic(stateside or overseas).
- Tip stall: Tip stall is an indicator of the scaler's efficiency in removing calculus. Four ounces of side load should be the maximum operator force used in scaling procedures.
- Water flow: Water flow is an important factor in determining scaler tip cooling and, therefore, patient comfort.
- Noise: The Air Force allows a decibel level of 100 for a cumulative exposure of 1/2 hour per day (the approximate amount of time the average dental handpiece is in action during an 8 h work day) (18). Because such measurements for dental scalers haven't been made, the 1/2 hour per day figure is used here.

### Design Quality and Maintainability

As a second part of Phase 1, the scalers were evaluated by the Maintenance Management Section, USAF School of Aerospace Medicine, Brooks Air Force Base, to answer design quality and maintainability questions.

- Quality of materials and construction: Scalers should be constructed of materials durable enough to withstand the rigors of everyday life (and use) in a dental clinic.
- Were maintenance instructions clear? Instructions should be readily understandable and easy to follow through a logical course of the scaler's use.
- Do maintenance requirements seem reasonable? Maintenance-free equipment is the ideal; otherwise, low maintenance levels are desirable.
- Was repair and maintenance access reasonable? The importance of access becomes obvious as the breakdown rate of a newly installed scaler seems to be relatively high until the machine adjustment is complete and all fittings have a chance to "settle in". Note, however, that this adjustment should not be as important if the unit is correctly bench tested at the factory prior to shipment. Such testing is known as burn-in..

The DIS evaluators collected data from these measurements and prepared a data synopsis (Appendix A). Further data may be found in the tables which accompany descriptions of each of the scalers in the Results section of this report.

Manufacturers were contacted for physical characteristics clarifications only when evaluators could not obtain the required information through direct observation or

through product literature review. Following the objective measurements and after testing each unit to ensure operability, DIS mailed the 14 scalers to the field for Part 2 of the study: the users' evaluation.

## PHASE 2: Clinical Evaluation

Phase 2 participants were health care providers from dental clinics at three military installations, Army, Navy, and Air Force. They were selected because of their varied experience and training levels in an attempt to evaluate the scalers from different users' viewpoints. The Air Force and Navy facilities each selected a periodontist, a dental hygienist, and a dental technician to be clinical evaluators; the Army selected a periodontist and five dental hygienists.

### Users' Experience Levels

The periodontists' experience levels ranged from 4 to 19 years; the average was 15 years. Two of the periodontists were certified by the National Board of Periodontists, while the third was board eligible. The hygienists' range of experience was from 4 to 22 years; the average was 15.1 years. All were registered dental hygienists. Of the two dental assistants who served as field evaluators, one had 3 years experience in the dental field; the other had just completed technician's school. Both technicians had received supervised, on-the-job training in addition to their military dental technician training schools. Both were certified by their supervising periodontists as capable of performing dental prophylaxis.

Manufacturers provided three units of each scaler model. Clinics therefore always received new, unused scalers for evaluation. The scalers were mailed to the field in random order, in groups of three to the Air Force and Navy bases, and in groups of six to the Army post. No attempt was made to arrange any specific order of evaluation. The users evaluated the 14 models of scalers for one week each, using them in their daily routines, substituting the test scalers for their everyday units. They recorded their impressions and comments on a field questionnaire entitled Scaler Evaluation Score Sheet, provided by DIS evaluators (Appendix B).

Evaluators at DIS tabulated the subjective raw scores from the field for each scaler based on the completed field questionnaires (Appendix C). They also recorded users' comments for each scaler. No attempt was made to calibrate the field evaluators beyond their similar levels of training and military service affiliations. Wherever two or more users made similar comments those comments were included in the study results.

### Statistical Analysis

Due to the number of evaluators and the variety of experience levels, as well as the varied evaluation sites, no reliable, interobserver statistical analyses were possible. Instead, raw data scores of the field site users are provided. Those scores, along with the descriptions of the individual scalers and the users' comments, provide a pool of information on which the reader can base purchasing decisions.

**PART II  
B. RESULTS**

**Ultrasonic Scalers - Magnetostrictive**

**Cranston Industries Inc., A/G 1050**

The Cranston A/G 1050 is a magnetostrictive ultrasonic scaler which uses plug-in, insert, sterilizable, scaler tips (clones of the Cavitron, Model 2002 and earlier, sterilizable, scaler inserts). These tips are not compatible with the newest, Model 3000 inserts from Cavitron. The A/G 1050 is packaged with two sterilizable scaler inserts, a water line with quick connect, and a handpiece rest which may be attached according to the user's needs.

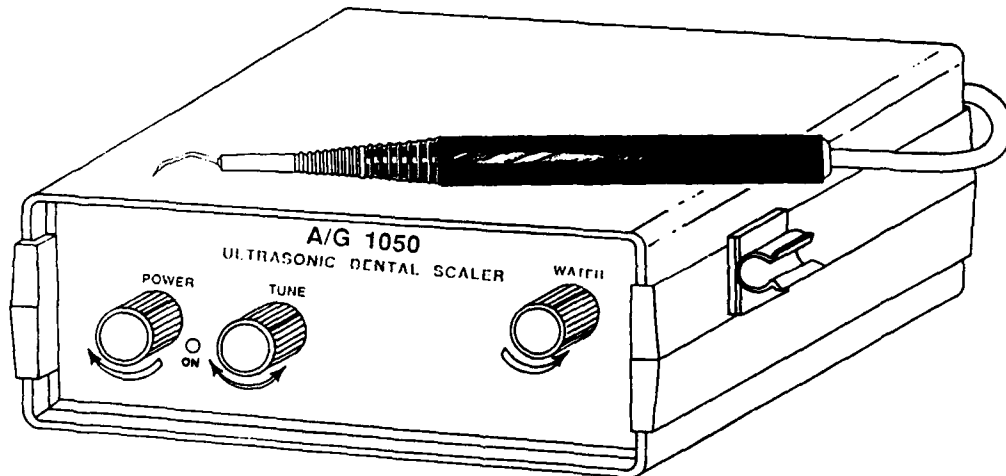


Figure 1. Cranston Industries A/G 1050.

TABLE 2. CRANSTON INDUSTRIES A/G 1050 - CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....10.25" X 13.4" X 19".....	1.51 cu ft
Gross Weight (including packing materials).....	11.1 lb
Dimensions of power generator.....	3.7"h X 8.5"w X 10.3"d
Minimum vertical space required for use.....	3.7"
Weight of power generator.....	5.5 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	114"
Weight of handpiece, cord, and scaler tip.....	5 oz
Length of handpiece with P-10 or equivalent tip.....	9.6"
Length of foot pedal cord.....	82"

Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	86.5 dB full power
(Background 37.4 dB) .....	85.0 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	77.8 dB full power
(Background 37.4 dB) .....	73.5 dB 1/2 power
Maximum water flow.....	208 cc/min at 74 psi
Pacemaker caution required.....	Yes

Quality of materials and construction of this unit are above average. Clarity of maintenance instructions, reasonability of maintenance requirements, and internal access for repair and maintenance were all above average.

Installation is fairly simple. The foot pedal, handpiece, and power cord arrive permanently attached to the power generator. The water hose must be attached to the back of the scaler control box. The water hose comes equipped with a universal quick connect fitting.

The following advantages/disadvantages are based on user comments, and technical evaluators' findings.

### Advantages

- Compatible with Cavitron inserts (Model 2002 and earlier).
- Equipped with all parts necessary for installation.
- Above average overall quality of construction.
- Troubleshooting guide provided.

### Disadvantages

- Inserts inferior in quality to the Cavitron inserts.
- Inserts too bulky.
- Narrow handpiece does not fit standard dental unit handpiece holder.
- Must be tuned after each insert change.

### Recommendation

Overall this unit was well received by the clinical and in-house evaluators alike. Although the quality of the inserts was poor, the fact that Cavitron inserts can be used in this machine is a big plus. The Cranston A/G 1050 ultrasonic scaler is rated "acceptable" for Department of Defense use.

## Dentsply Cavitron 3000

The Dentsply Cavitron 3000 is, like Cavitron's previous models, a magnetostrictive ultrasonic scaler. It differs from its predecessors in that the insert used for this model is shorter. Previous inserts will not work in this model. The model 3000 oscillates at 30,000 Hz, as opposed to the 25,000 Hz of previous Cavitron models. It comes packaged with three sterilizable inserts (30K-EWPP, 30K-3, and 30K-10).

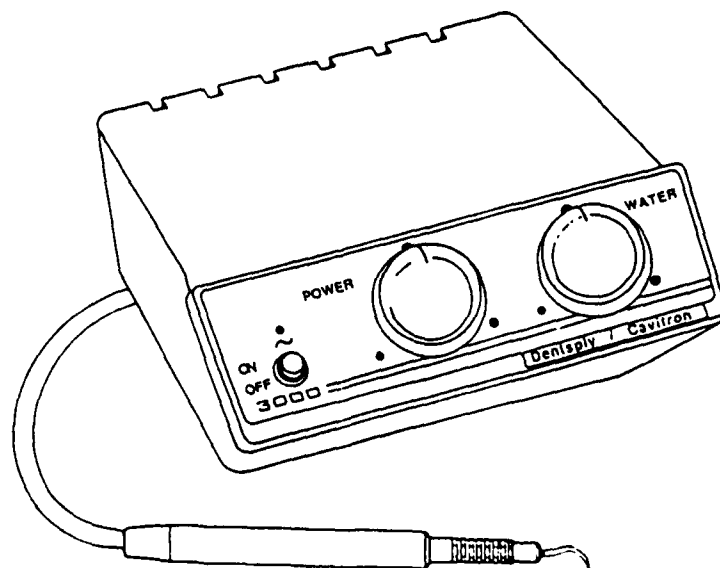


Figure 2. Dentsply International Cavitron 3000.

TABLE 3. DENTSPLY CAVITRON 3000 CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	No
Size in box.....9" X 13" X 15.5".....	1.05 cu ft
Gross Weight (including packing materials).....	8.5 lb
Dimensions of power generator.....	4"h X 8.25"w X 8"d
Minimum vertical space required for use.....	4"
Weight of power generator.....	4.75 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	80"
Weight of handpiece, cord, and scaler tip.....	5 oz
Length of handpiece with P-10 or equivalent tip.....	8"
Length of foot pedal cord.....	94"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	22 oz
Maximum audible noise at 3" from scaler tip.....	73.5 dB full power
(Background 37 dB) .....	65.0 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	64.5 dB full power
(Background 37 dB) .....	55.0 dB 1/2 power
Maximum water flow.....	91 cc/min at 74 psi
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are above average. Clarity of maintenance instructions, reasonability of maintenance requirements, and ease of internal access for repair and maintenance are all above average.

Installation of this scaler is complicated by the absence of a universal water quick connect. A new one must be located, or the connector from the previous scaler must be removed and installed on the Cavitron 3000 so it can be plugged into the dental unit.



The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Low noise levels.
- Smaller handpiece than earlier Cavitron models; easy to handle.
- Plenty of power.

### Disadvantages

- New Cavitron 3000 inserts not compatible with previous models' inserts.
- Delivered without universal, quick connect for water.
- Scaler handpiece (stack within the handpiece) produced significant heat which users had difficulty controlling.
- Insert tips too bulky for optimal subgingival use.

### Recommendation

Although the insert tips are very much like previous Cavitron models, their stack length (and therefore the insert length) is shorter. Old inserts may not be used on the new Cavitron 3000. In spite of this finding, the Cavitron 3000 remains a high-quality instrument and was well received by both clinical and in-house evaluators. It is therefore rated "recommended" for Department of Defense use.

### Engler Engineering Corp. Sonus V

The Engler Sonus V is a magnetostrictive, ultrasonic scaler which uses a sterilizable nose cone and screw-in sterilizable scaler tips. In this model the iron-nickel

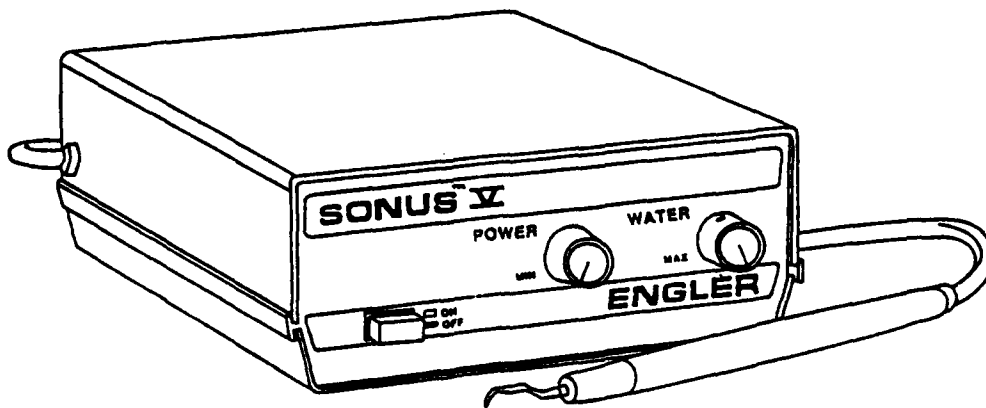


Figure 3. Engler Engineering Corp., Sonus V.

stack is a part of the handpiece, with only the tips normally changed during use. Such an arrangement helps lower the cost of scaler tips, an infection control consideration. The user may choose to buy extra stacks and nose cones, attach them to the tip, and use the entire assembly much like the Cavitron-style insert. Such an arrangement would, however, negate the cost savings of buying the tips alone. The Sonus V comes with five scaler tips, a tip wrench, and removable handpiece with cord, one nose cone, one stack, footswitch, and water supply hoses. Additional stacks and nose cones are available.

**TABLE 4. ENGLER SONUS V CHARACTERISTICS**

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....7.25" X 12.2" X 13.25".....	0.68 cu ft
Gross Weight (including packing materials).....	10.9 lb
Dimensions of power generator.....	3.4"h X 8.5"w X 10.5"d
Minimum vertical space required for use.....	3.4"
Weight of power generator.....	6.3 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	96.75"
Weight of handpiece, cord, and scaler tip.....	5 oz
Length of handpiece with P-10 or equivalent tip.....	8.6"
Length of foot pedal cord.....	77"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	85 dB full power
(Background 37.5 dB).....	85 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	77 dB full power
(Background 37 dB).....	76 dB 1/2 power
Maximum water flow.....	160 cc/min at 74 psi
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are far above average. Clarity of maintenance instructions, reasonability of maintenance requirements, and ease of internal access for repair and maintenance are all above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Sturdy unit and footswitch construction.
- Plenty of power.
- User decides configuration of tip, i.e., screw-in tip, or insert.

## Disadvantages

- Screw-in tips more difficult to install and remove than Cavitron-style inserts. However, user may configure tip nose cone, and stack as a single insert unit.
- Tips generally difficult to manipulate subgingivally.

## Recommendation

Overall, since in-house as well as clinical testing and evaluation results were favorable, this scaler is rated above average. The Engler Engineering Corporation Sonus V ultrasonic dental scaler is therefore rated "recommended" for Department of Defense use.

### Engler Engineering Corp. Ultrason 990

The Engler Ultrason 990 is a magnetostrictive, ultrasonic scaler which uses a sterilizable nose cone and screw-in sterilizable scaler tips. In this model the iron-nickel stack is a part of the handpiece, with only the tips normally changed during use. Such an arrangement helps lower the cost of scaler tips, an infection control consideration. The user may choose to buy extra stacks and nose cones, attach them to the tip, and use the entire assembly much like the Cavitron-style insert. Such an arrangement would, however, negate the cost savings of buying the tips alone. The Ultrason 990 comes with four scaler tips, a tip wrench, and removable handpiece with cord, one nose cone, one stack, footswitch, and water supply hoses. Additional stacks and nose cones are available.

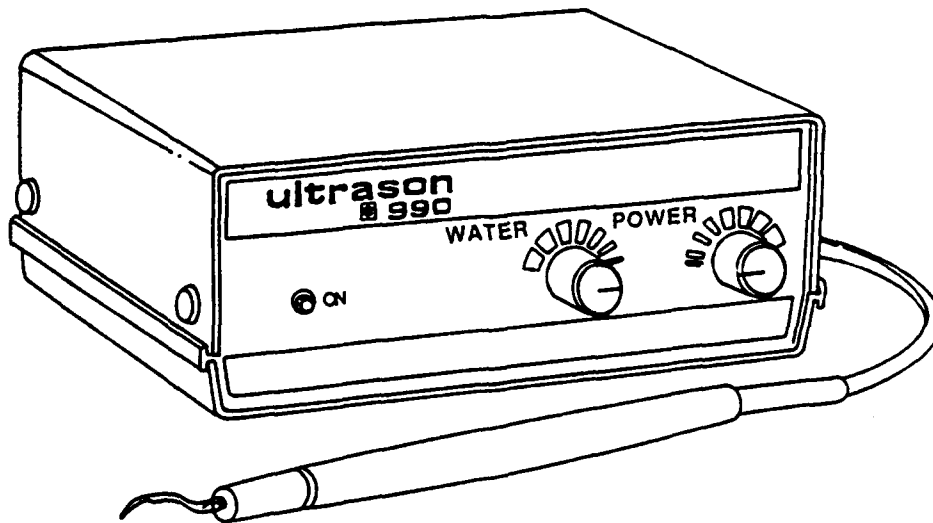


Figure 4. Engler Engineering Corp., Ultrason 990.

TABLE 5. ENGLER ULTRASON 990 CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....7.25" X 12.2" X 13.25".....	0.68 cu ft
Gross Weight (including packing materials). ....	10.9 lb
Dimensions of power generator.....	3.25"h X 8.9"w X 7.25"d
Minimum vertical space required for use.....	3.25"
Weight of power generator.....	6.1 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	93"
Length of handpiece with P-10 or equivalent tip.....	8.5"
Weight of handpiece, cord, and scaler tip.....	5 oz
Length of foot pedal cord.....	76"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	84 dB full power
(Background 38 dB) .....	82 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	79 dB full power
(Background 37 dB) .....	76 dB 1/2 power
Maximum water flow.....	236 cc/min at 74 psi
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are rated far above average. Clarity of maintenance instructions, reasonability of maintenance requirements, and ease of internal access for repair and maintenance are all above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Sturdy unit and footswitch construction.
- Plenty of power.
- Screw-in tips are approximately 25% less expensive than insert style tips (\$25 vs \$35).

### Disadvantages

- Screw-in tips are more difficult to install and remove than Cavitron-style inserts. However, user may configure tip nose cone, and stack as a single insert unit.
- Tips are generally difficult to manipulate subgingivally due to their large size.

### Recommendation

Overall, in-house as well as field testing and evaluation results were favorable, rating this scaler above average. The Engler Engineering Corporation Ultrason 990 ultrasonic dental scaler is therefore rated "recommended" for Department of Defense use.

## Parkell Le Clean Machine, Model D 550

The Parkell Le Clean Machine is a magnetostrictive ultrasonic scaler which uses plug-in, sterilizable scaler tips (Cavitron, Model 2002 and earlier style, sterilizable, scaler inserts). The unit is not supplied with inserts. They must be purchased separately. It comes with a foot switch and cord, handpiece and cord, and water line with quick-connect fitting. All cords and hoses are permanently attached.

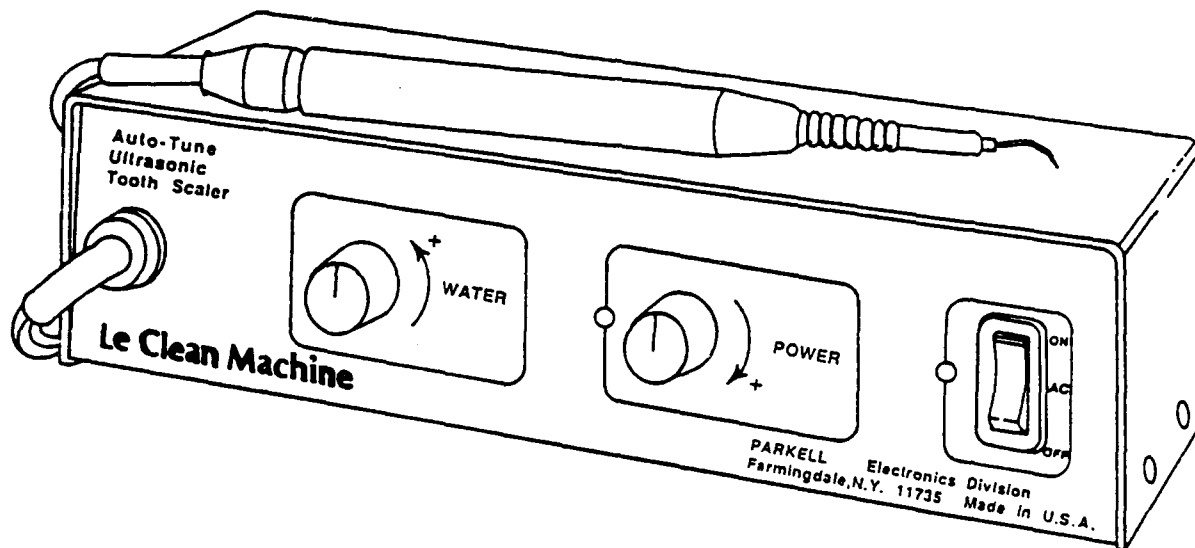


Figure 5. Parkell Le Clean Machine.

TABLE 6. PARKELL LE CLEAN MACHINE CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....7" X 10.1" X 13.25".....	0.54 cu ft
Gross Weight (including packing materials).....	6.7 lb
Dimensions of power generator.....	3.25"h X 11.25"w X 5.75"d
Minimum vertical space required for use.....	3.25"
Weight of power generator.....	4.25 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	73.25"
Length of handpiece with P-10 or equivalent tip.....	8.25"
Weight of handpiece, cord, and scaler tip.....	4 oz
Length of foot pedal cord.....	70"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	83 dB full power
(Background 38 dB).....	81 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	70.5 dB full power
(Background 38 dB).....	69 dB 1/2 power

Maximum water flow.....	92 cc/min at 74 psi
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are above average, except for the foot pedal which received clinical comments of "flimsy," "heavy pressure is required for foot control," and "foot pedal is too light to be stable." Clarity of maintenance instructions and reasonability of maintenance requirements are average. Ease of internal access for repair and maintenance is above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Uses Cavitron, Model 2002 and earlier, sterilizable, scaler inserts.

### Disadvantages

- Scaler tips purchased separately.
- Plastic foot pedal flimsy, too light to be stable.
- Foot pedal cord too short for optimal use.
- Permanently attached cords difficult to "gather up" when moving scaler to another treatment area.
- Tips excessively hot even with maximum water flow.

### Recommendation

Overall, in-house as well as field testing and evaluation results were mixed; the clinical investigators disagreed on the acceptability of this unit. Although the Parkell Le Clean Machine, Model D 550, ultrasonic dental scaler is rated "acceptable" for Department of Defense use, potential buyers should be aware of its shortcomings as noted above.

### Simplified Systems Sonatron S3M

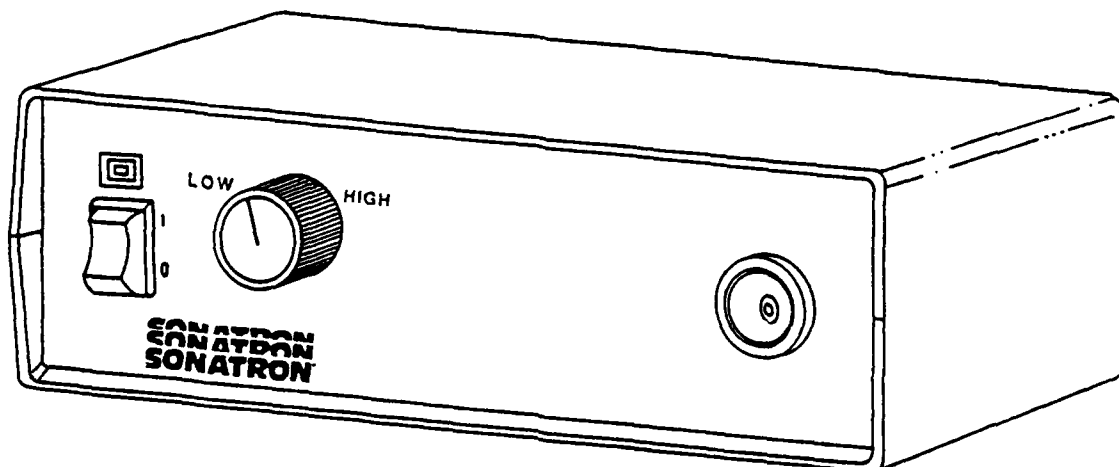


Figure 6. Simplified Systems Sonatron S3M.

The Simplified Systems Sonatron S3M is a magnetostrictive, ultrasonic scaler which uses plug-in, sterilizable scaler tips or inserts. The connector hose hooks up to one of the dental unit handpiece station hoses to obtain its water supply. The water flow rate is therefore not controlled by the scaler unit but by the dental unit control head. It uses Cavitron-style inserts from Model 2002 and earlier, three of which are supplied with the unit. This scaler is controlled by the dental unit foot pedal.

TABLE 7. SIMPLIFIED SYSTEMS SONATRON S3M CHARACTERISTICS

Installation/Operating instructions.....	None
Troubleshooting instructions.....	None
Size in box.....5" X 12.4" X 16.5".....	0.59 cu ft
Gross Weight (including packing materials).....	5.25 lb
Dimensions of power generator.....	2.9"h X 8.25"w X 7.5"d
Minimum vertical space required for use.....	2.9"
Weight of power generator.....	1.6 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Uses dental unit water control
Length of handpiece cord.....	95"
Length of handpiece with P-10 or equivalent tip.....	9"
Weight of handpiece, cord, and scaler tip.....	5.5 oz
Length of foot pedal cord.....	None
Non-skid bottom surface on foot pedal.....	No foot pedal
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	20 oz
Maximum audible noise at 3" from scaler tip.....	83 dB full power
(Background 37 dB).....	74.5 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	71.5 dB full power
(Background 36 dB).....	63.5 dB 1/2 power
Maximum water flow.....	90 cc/min at 74 psi (Adec dental unit)
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are above average. No instructions were received with the machine, nor did the manufacturer provide any after several inquiries. Ease of internal access for repair and maintenance is above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Compatible with Cavitron-style scaler inserts (Model 2002 and earlier).

### Disadvantages

- No instructions supplied with the unit.
- Provided Cavitron-style scaler insert tips low quality.
- Power generator must sit on bracket table because it attaches to one of the handpiece hoses.

- Large transformer requires much space to plug into wall receptacle. Cord then drapes from wall socket across bracket table to power generator.

### Recommendation

The Sonatron S3M never could be made to operate properly at one location, although the field users who were able to make it operate, rated it above average overall. It had neither operating nor troubleshooting instructions. It requires a dental unit handpiece hose station for water supply and must be placed on the dental unit bracket table where it is unstable due to its light weight. These factors, along with the ease with which it can be pulled off the bracket table onto the patient, make this scaler of questionable value in the overall estimation of DIS and clinical evaluators. The Simplified Systems Sonatron S3M is therefore rated "not recommended" for Department of Defense use.

### Simplified Systems Sonatron S3X

The Simplified Systems Sonatron S3X is a magnetostrictive ultrasonic scaler which uses plug-in sterilizable scaler tips or inserts (clones of the Cavitron, Model 2002 and earlier style, sterilizable, scaler inserts). The unit is supplied with three inserts. It comes with foot switch and cord, handpiece and cord, and water line with quick-connect fitting. The power cord and water supply cord are permanently attached to the power generator. The handpiece and foot pedal cords are removable. The user attaches the handpiece holder (rest) to the power generator with double-faced tape, positioning it according to clinical needs.

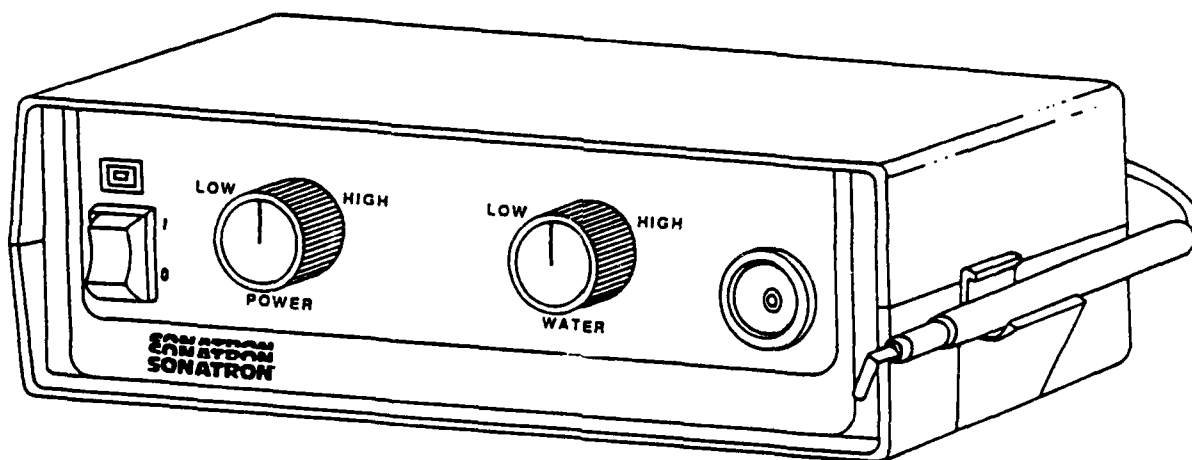


Figure 7. Simplified Systems Sonatron S3X.

TABLE 8. SIMPLIFIED SYSTEMS SONATRON S3X CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	No
Size in box.....5" X 12. 4" X 16.1".....	0.58 cu ft
Gross Weight (including packing materials).....	7.1 lb
Dimensions of power generator.....	2.9"h X 8.9"w X 7.5"d
Minimum vertical space required for use.....	2.9"
Weight of power generator.....	2.4 lb



Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	94.25"
Length of handpiece with P-10 or equivalent tip.....	9.75"
Weight of handpiece, cord, and scaler tip.....	4.5 oz
Length of foot pedal cord.....	97"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	82 dB full power
(Background 38 dB) .....	79 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	72 dB full power
(Background 37.5 dB) .....	67 dB 1/2 power
Maximum water flow.....	140 cc/min at 74 psi
Pacemaker caution required.....	Yes

The quality of materials and construction of this scaler are average. There were no instructions initially supplied with the units received by DIS, but a call to the manufacturer corrected this problem. Ease of internal access for repair and maintenance is above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Works similarly to Cavitron 2002 - insert scaling tips interchangeable with Cavitron scalers (Model 2002 and earlier).

### Disadvantages

- Tips appeared to be inferior clones of Cavitron tips.
- Large power transformer monopolizes the wall plug space.

### Recommendation

Overall, since in-house as well as field testing and evaluation results were favorable, this scaler is rated just above average. The Simplified Systems Sonatron S3X ultrasonic dental scaler is therefore rated "acceptable" for Department of Defense use.

## Ultrasonic Scalers - Piezoelectric

### Health Science Products HSP Ultrasonic

The HSP Ultrasonic is a piezoelectric, ultrasonic scaler which uses screw-in, sterilizable scaler tips. In this model a crystal system is the vibratory force behind the scaler tip. It comes with four scaler tips, requiring the use of a wrench (provided) to tighten and remove the tips. This unit arrived without instructions, but a call to the supplier corrected the problem. The scaler comes with handpiece cord and water supply line permanently attached. The power and foot switch cords are detachable.

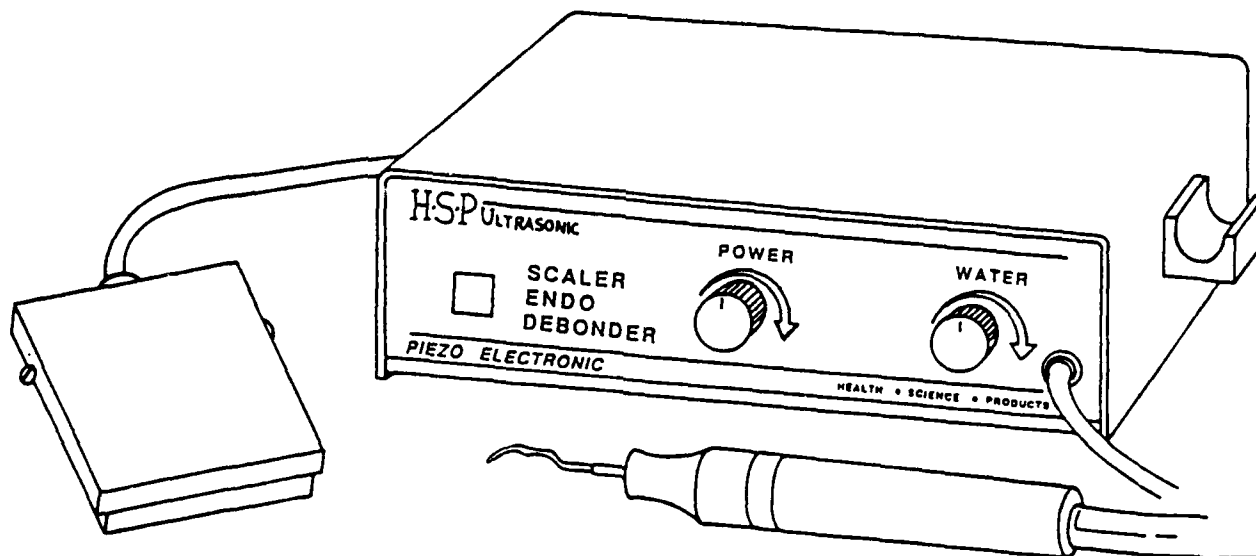


Figure 8. Health Science Products HSP Ultrasonic Scaler.

TABLE 9. HEALTH SCIENCE PRODUCTS HSP ULTRASONIC CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	No
Size in box.....6" X 9.25" X 13.1".....	0.42 cu ft
Gross Weight (including packing materials).....	4.9 lb
Dimensions of power generator.....	2.6"h X 9.8"w X 8.6"d
Minimum vertical space required for use.....	2.6"
Weight of power generator.....	2.9 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	74.75"
Length of handpiece with P-10 or equivalent tip.....	6.25"
Weight of handpiece, cord, and scaler tip.....	4 oz
Length of foot pedal cord.....	96.75"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	51 dB full power
(Background 38 dB).....	50 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	47 dB full power
(Background 37 dB).....	43 dB 1/2 power
Maximum water flow.....	208 cc/min at 74 psi
Pacemaker caution required.....	No

The quality of materials and construction of this scaler are average. Instructions did not arrive with the machine, but were provided later upon request. The instructions ultimately provided were minimal (one page), without pictures or troubleshooting information. Clarity of maintenance instructions is below average. Reasonability of maintenance requirements was average. Ease of internal access for repair and maintenance is average. Electrical schematics were not provided.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

## Advantages

- Very easy to install.
- Economical screw-in tips.
- Water flow not required to keep the handpiece cool.
- Lightweight and easy to move from operator to operator.

## Disadvantages

- Calculus removal described by some clinical evaluators as not as effective as other units.
- Water control difficult to operate - no positive stops in either on or off positions.
- Screw-in tips require a wrench to install and remove.
- Tips too large for optimal subgingival calculus removal.

## Recommendation

Clinical users were divided on their appraisals of this scaler. Navy and Air Force users were quite pleased with it, but Army evaluators found it ranged from average to unacceptable. Overall, through in-house as well as field testing and evaluation results this scaler is rated just above average. The Health Science Products Piezo electric HSP Ultrasonic dental scaler is therefore rated "acceptable" for Department of Defense use.

### Satelec SP-Quick

The Satelec SP-Quick is a piezoelectric, ultrasonic scaler which uses screw-in, sterilizable scaler tips. In this model a crystal system is the vibratory force behind the scaler tip. It comes with four scaler tips, requiring the use of a wrench (provided) to tighten and remove the tips. The scaler comes with a power transformer pack that is mounted on the electrical wall plug. The power cord is removable from the scaler unit. This scaler attaches to one of the handpiece hoses of the dental unit for its water supply and makes use of the dental unit foot pedal for on - off control. The handpiece cord is permanently attached.

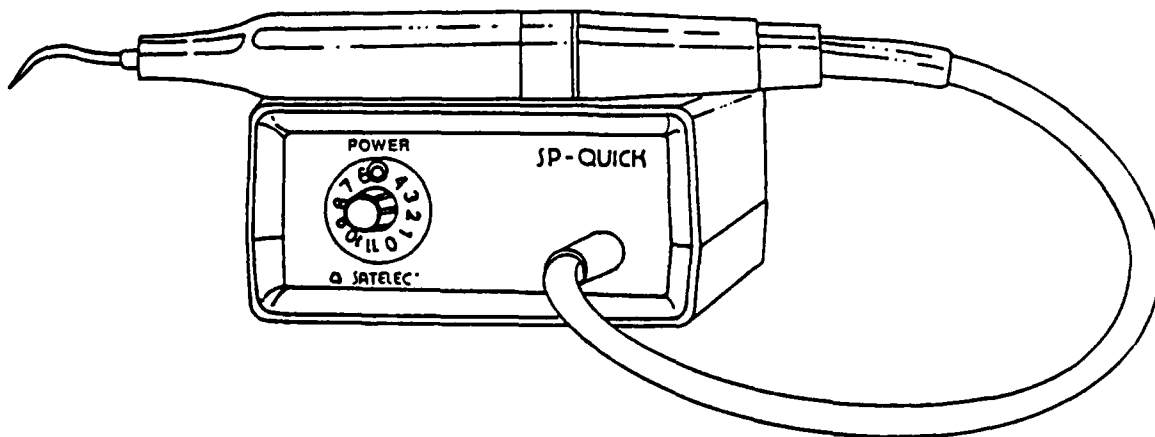


Figure 9. Satelec SP-Quick.

TABLE 10. SATELEC SP-QUICK CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in boxes.....4.9" X 8" X 11.5".....	0.26 cu ft
3.5" X 4.25" X 5.5".....	0.08 cu ft
Gross Weight (including packing materials).....	4.3 lb
Dimensions of power generator.....	1.9"h X 3.7"w X 7"d
Minimum vertical space required for use.....	1.9"
Weight of power generator.....	0.9 lb
Non-skid bottom surface on power generator.....	Sticky-backed non-skid feet provided in box.
Separate, variable power and water controls.....	Yes, uses dental unit power control.
Length of handpiece cord.....	97.5"
Length of handpiece with P-10 or equivalent tip.....	7.5"
Weight of handpiece, cord, and scaler tip.....	5 oz
Length of foot pedal cord.....	Uses dental unit foot pedal
Non-skid bottom surface on foot pedal.....	N/A
Electrical specifications.....	110/120 V, 50/60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	67.5 dB full power
(Background 36.5 dB).....	72 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	58.5 dB full power
(Background 35.5 dB).....	60.5 dB 1/2 power
Maximum water flow.....	depends on dental unit
Pacemaker caution required.....	No

The quality of materials and construction of this scaler are above average. The instruction manual's table of contents listed Section 1 as a description section, but there is no such section. Clarity of maintenance instructions is average. Reasonability of maintenance requirements and ease of internal access for repair and maintenance are above average. No electrical schematics were provided.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Economical screw-in tips.
- Lightweight.

### Disadvantages

- Screw-in tips require wrench to install/remove
- Tips too large for optimal subgingival calculus removal
- Large transformer monopolizes electrical outlet

### Recommendation

Overall, through in-house as well as field testing and evaluation this scaler is rated just above average. DIS evaluators had difficulty locating the company's USA office. As of this writing, the company, located in France, no longer sells this product directly. The Satelec SP-Quick piezoelectric ultrasonic dental scaler is rated "acceptable" by

DIS for Department of Defense use, but buyers should check for adequate customer support before purchasing.

Spartan USA, The Piezo-Electric

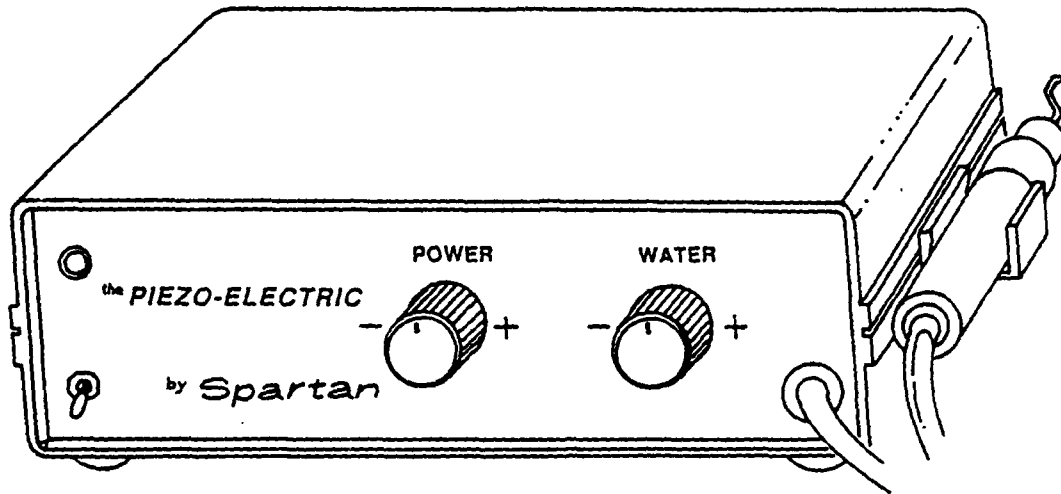


Figure 10. Spartan USA The Piezo-Electric.

The Piezo-Electric by Spartan USA is, as its name implies, a piezoelectric, ultrasonic scaler. It uses screw-in, sterilizable scaler tips. In this model a crystal system is the vibratory force behind the scaler tip. It comes with three scaler tips, requiring the use of a wrench (provided) to tighten and remove the tips. The scaler comes with handpiece cord, power cord, and foot pedal cord permanently attached. The water supply line must be fitted to the scaler upon arrival. Once attached, it too is meant to be permanently attached. A universal, water quick-connect is provided for the connection between the scaler and the dental unit.

TABLE 11. SPARTAN USA THE PIEZO-ELECTRIC CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	No
Size in box.....6.75" X 8.5" X 10.25".....	0.34 cu ft
Gross Weight (including packing materials).....	4.5 lb
Dimensions of power generator.....	2.8"h X 9"w X 7.2"d
Minimum vertical space required for use.....	2.8"
Weight of power generator.....	2.6 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	73.25"
Length of handpiece with P-10 or equivalent tip.....	6.75"

Weight of handpiece, cord, and scaler tip.....	4 oz
Length of foot pedal cord.....	76"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	69 dB full power
(Background 37.5 dB) .....	67 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	60 dB full power
(Background 37 dB) .....	58.5 dB 1/2 power
Maximum water flow.....	128 cc/min at 74 psi
Pacemaker caution required.....	No

The quality of materials and construction of this scaler are average. Clarity of maintenance instructions is above average. Reasonability of maintenance requirements is average. Ease of internal access for repair and maintenance is above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Economical screw-in tips.
- Lightweight.

### Disadvantages

- Calculus removal not as effective as other units.
- Screw-in tips require wrench to install/remove.
- Tips not ideal for subgingival calculus removal.
- Permanently attached cords difficult to "gather up" to move to other treatment areas.

### Recommendation

Overall, through in-house as well as field testing and evaluation, this scaler is rated just above average. The Piezo-Electric by Spartan USA ultrasonic dental scaler is therefore rated "acceptable" for Department of Defense use.

## Young Dental Manufacturing Ultra-Scaler 3100

The Young Dental Mfg. Ultra-Scaler 3100 is a piezoelectric, ultrasonic scaler which uses screw-in, sterilizable scaler tips. In this model a crystal system is the vibratory force behind the scaler tip. It comes with three scaler tips, requiring the use of a wrench (provided) to tighten and remove the tips. The scaler comes with foot switch cord, power cord, handpiece cord, and water supply line, all permanently attached. The water supply line has a universal, quick connect fitting. The foot switch is two-stage. When it is partially depressed, it turns the scaler on with water lavage; when the switch is fully depressed, there is water lavage only.

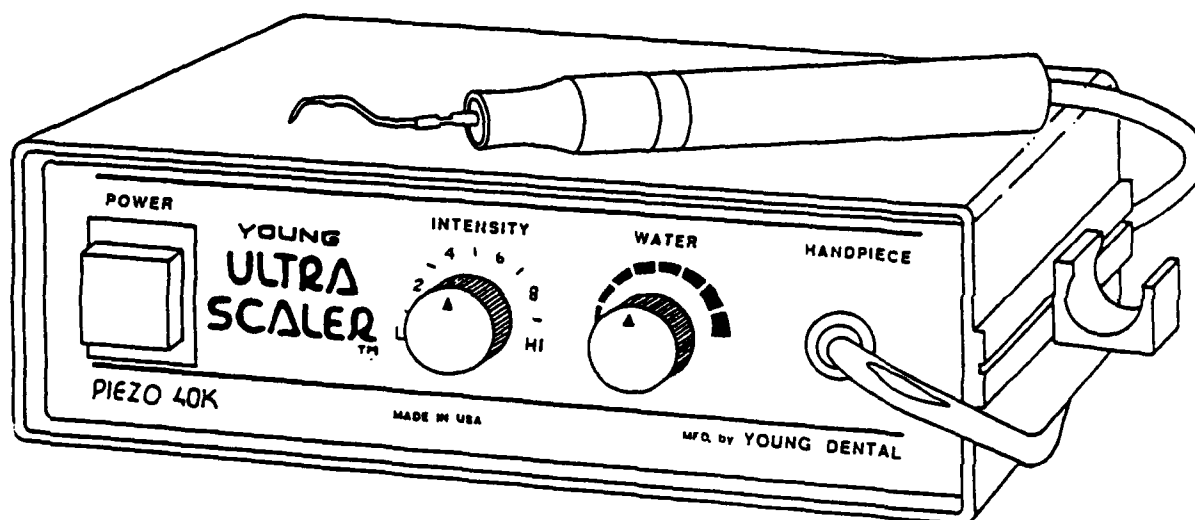


Figure 11. Young Dental Manufacturing Ultra-Scaler 3100.

TABLE 12. YOUNG DENTAL MFG. ULTRA-SCALER 3100 CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	No
Size in box.....6.8" X 9." X 12.5".....	0.44 cu ft
Gross Weight (including packing materials).....	5.9 lb
Dimensions of power generator.....	2.8"h X 9.3"w X 7.5"d
Minimum vertical space required for use.....	2.8"
Weight of power generator.....	2.9 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	73"
Length of handpiece with P-10 or equivalent tip.....	6.75"
Weight of handpiece, cord, and scaler tip.....	4 oz
Length of foot pedal cord.....	95"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	69.5 dB full power
(Background 37 dB)	65 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	57 dB full power
(Background 37.5 dB)	55.5 dB 1/2 power
Maximum water flow.....	186 cc/min at 74 psi
Pacemaker caution required.....	No

The quality of materials and construction of this scaler is above average. Clarity of written maintenance instructions and reasonability of maintenance requirements is average. Ease of internal access for repair and maintenance is far above average. No electrical schematics were provided. However, pictures of available tips and a VHS instruction and demonstration tape are outstanding additions to the scaler package.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Video tape instructions provided.
- Economical screw-in tips.
- Water flow not required to keep the handpiece cool.
- Rinsing cycle on two-stage foot pedal.

### Disadvantages

- Two-stage foot pedal difficult for some people to control.
- Screw-in tips require wrench to install/remove.
- Tips too large for optimal subgingival calculus removal.

### Recommendation

Clinical evaluators were split in their opinions of this unit. While some specifically remarked that they liked the foot pedal's operation (a bi-level pedal that operates the scaler and water when pressed partially to the floor, and operates only the water when pressed all the way to the floor), others were uncomfortable with it. Overall, through in-house as well as field testing and evaluation, this scaler is rated above average. The VHS videotaped instructions were quite well received by clinical evaluators. One of the scalers developed an electrical short in its "on" indicator light, making it difficult for users to tell if the unit was on or off. That problem is considered minor; therefore, the Young Dental Manufacturing Ultra-Scaler 3100 is rated "acceptable" for Department of Defense use.

### Young Dental Manufacturing Ultra-Scaler 3200

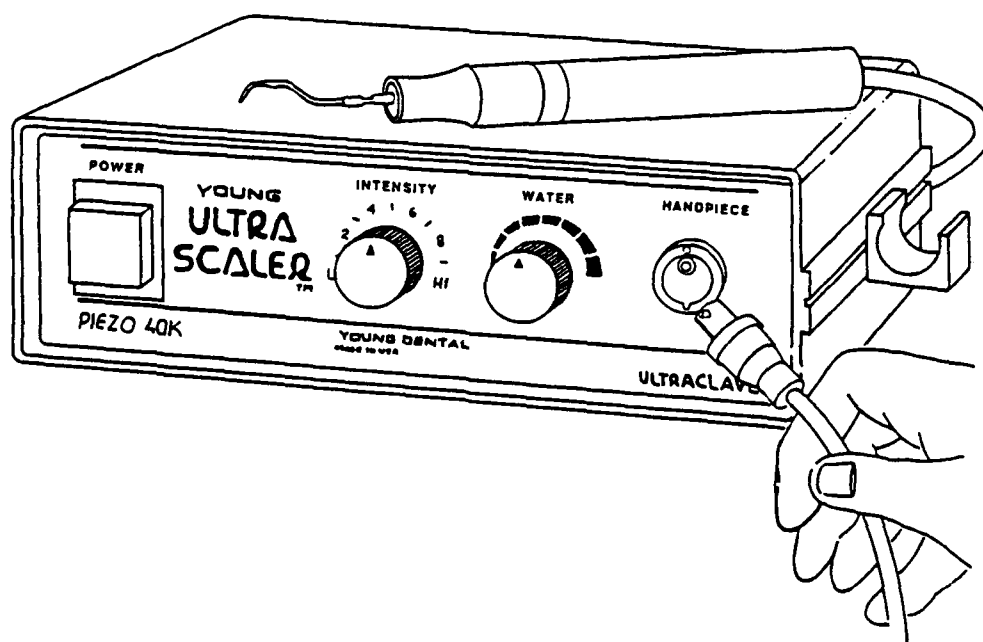


Figure 12. Young Dental Manufacturing Ultra-Scaler 3200.



TABLE 13. YOUNG DENTAL MFG. ULTRA-SCALER 3200 CHARACTERISTICS

Installation/Operating instructions.....	Yes (VHS Videotape)
Troubleshooting instructions.....	No
Size in box.....6.5" X 8.5" X 10.3".....	0.33 cu ft
Gross Weight (including packing materials).....	5.7 lb
Dimensions of power generator.....	2.8"h X 9.3"w X 7.5"d
Minimum vertical space required for use.....	2.8"
Weight of power generator.....	2.9 lb
Non-skid bottom surface on power generator.....	Yes
Separate, variable power and water controls.....	Yes
Length of handpiece cord.....	77"
Length of handpiece with P-10 or equivalent tip.....	6.75"
Weight of handpiece, cord, and scaler tip.....	6 oz
Length of foot pedal cord.....	95"
Non-skid bottom surface on foot pedal.....	Yes
Electrical specifications.....	110, 220 V; 50, 60 Hz
Tip stall: side load required.....	18 oz
Maximum audible noise at 3" from scaler tip.....	63.5 dB full power
(Background 38 dB ) .....	59.5 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	44 dB full power
(Background 38 dB ) .....	41 dB 1/2 power
Maximum water flow.....	190 cc/min at 74 psi
Pacemaker caution required.....	No

The Young Dental Mfg. Ultra-Scaler 3200 is a piezoelectric, ultrasonic scaler which uses screw-in, sterilizable scaler tips. In this model a crystal system is the vibratory force behind the scaler tip. It comes with three scaler tips, requiring the use of a wrench (provided) to tighten and remove the tips. The scaler comes with foot switch cord, power cord, and water supply line permanently attached. The water supply line has a standard, quick-connect fitting. The handpiece cord is detachable for increased ease of disinfection. The foot switch is two-stage. When it is partially depressed, it turns the scaler on with water lavage; when the switch is fully depressed, there is water lavage only.

The quality of materials and construction of this scaler are rated above average. There were no written instructions with the unit. However, a VHS-format VCR instruction/demonstration tape is an outstanding addition to the scaler package. Ease of internal access for repair and maintenance is far above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Video tape instructions provided.
- Economical screw-in tips.
- Water flow not required to keep handpiece stack cool.
- Two-stage foot pedal includes rinsing cycle.

## Disadvantages

- Two-stage foot pedal difficult for some people to control.
- Screw-in tips require wrench to install/remove.
- Tips too large for optimal subgingival calculus removal.

## Recommendation

Overall, through in-house as well as field testing and evaluation, this scaler is rated just above average. One of the scalers provided for the field testing developed mechanical difficulties making it unusable. The others, however, functioned well. The Young Dental Manufacturing Ultra-Scaler 3200 is therefore rated "acceptable" for Department of Defense use.

## Sonic Scalers

### Den-Tal-Ez Star Titan-S

The Star Dental Titan-S is a sonic scaler which uses screw-in, sterilizable scaler tips. An air-driven turbine provides the vibratory force behind the scaler tip. It comes with three scaler tips, requiring the use of a wrench (provided) to remove the tips. The manufacturer stresses that tips are not to be tightened with the wrench -- only removed. The scaler model evaluated in this study comes as a handpiece and simulator gauge (used to set dental unit air pressure at the handpiece station), and has a spare rotor kit. A new model currently available comes equipped with a 360 degree handpiece hose swivel, but without the air pressure gauge. The Titan-S scaler depends on a dental unit handpiece station for its drive air and spray coolant. It is switched on and off by the dental unit foot control.

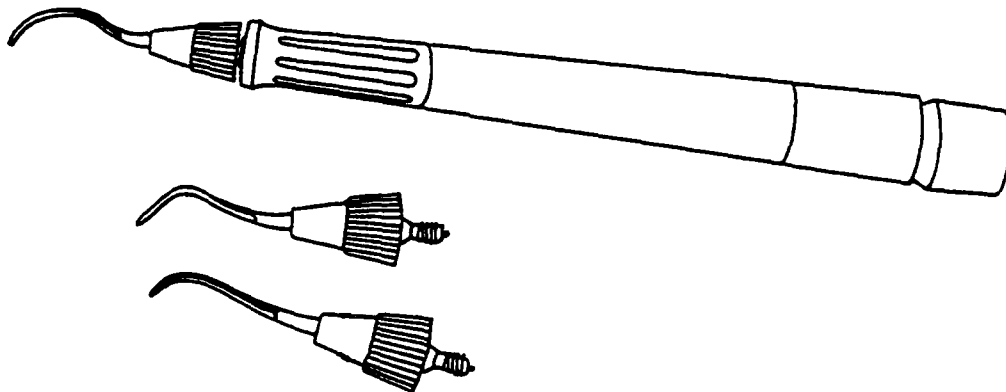


Figure 13. Den-Tal-Ez Star Titan-S.

TABLE 14. DEN-TAL-EZ STAR TITAN-S CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....2.3" X 5.3" X 7.3".....	0.05 cu ft
Gross Weight (including packing materials).....	1 lb
Dimensions of power generator.....	N/A, Handpiece only
Minimum vertical space required for use.....	N/A
Weight of power generator.....	N/A
Non-skid bottom surface on power generator.....	N/A
Separate, variable power and water controls.....	No, varies with dent. unit.
Length of handpiece cord.....	Varies with dental unit.
Length of handpiece with P-10 or equivalent tip.....	6.75"
Weight of handpiece, cord, and scaler tip.....	3 oz
Length of foot pedal cord.....	Varies with dental unit.
Non-skid bottom surface on foot pedal.....	N/A
Electrical specifications.....	N/A
Tip stall: side load required.....	> 32 oz
Maximum audible noise at 3" from scaler tip.....	82 dB full power
(Background 37 dB ) .....	82 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	78.5 dB full power
(Background 35.5 dB ) .....	71.5 dB 1/2 power
Maximum water flow.....	Varies with dental unit.
Pacemaker caution required.....	No

The quality of materials and construction of this scaler are far above average. Clarity of maintenance instructions is above average. Reasonability of maintenance requirements is average, and ease of internal access for repair and maintenance is far above average.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Convenient to have a scaler "at the ready" like a dental handpiece.
- Economical screw-in tips.
- Tips good for subgingival use (but not offset for posterior use).
- Uses dental unit foot pedal for on-off control.
- Decreased patient discomfort.

### Disadvantages

- Depends on the availability of handpiece station at the dental unit.
- May take repeated action to remove heavy calculus.

### Recommendation

Overall, through in-house as well as field testing and evaluation, this scaler is rated above average. The Star Dental Titan-S is therefore rated "recommended" for Department of Defense use.

## Kavo America SONICflex 2000

The Kavo America SONICflex 2000 is a sonic scaler which uses screw-in, sterilizable scaler tips. An air-driven turbine provides the vibratory force behind the scaler tip. It comes with three scaler tips, requiring the use of a wrench (provided) to remove the tips. The manufacturer stresses that tips are not to be tightened with the wrench -- only loosened. The scaler comes as a handpiece, multiflex coupling (360° swivel), and is packaged with a can of lubricant. This scaler depends on a dental unit handpiece station for its drive air and spray coolant. It is switched on and off by the dental unit foot control.

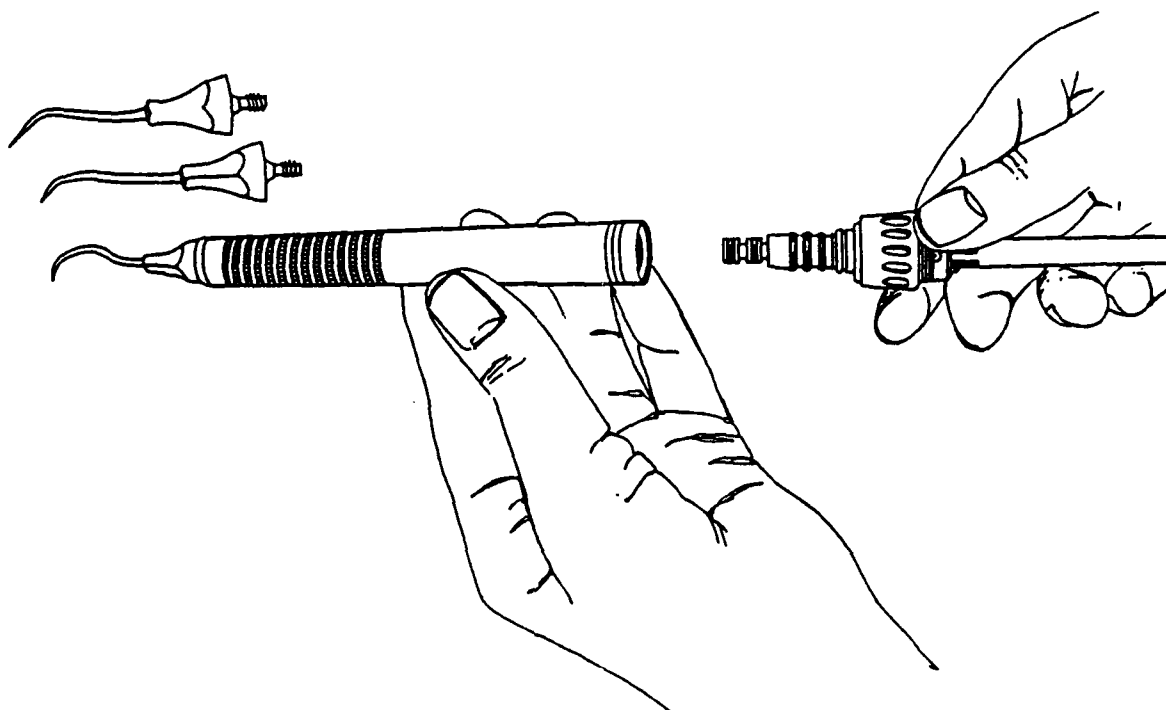


Figure 14. Kavo America SONICflex 2000.

TABLE 15. KAVO AMERICA SONICFLEX 2000 CHARACTERISTICS

Installation/Operating instructions.....	Yes
Troubleshooting instructions.....	Yes
Size in box.....6.5" X 9" X 8".....	0.27 cu ft
Gross Weight (including packing materials).....	3.8 lb
Dimensions of power generator.....	N/A, Handpiece only
Minimum vertical space required for use.....	N/A
Weight of power generator.....	N/A
Non-skid bottom surface on power generator.....	N/A
Separate, variable power and water controls.....	No, Varies with dent. unit.
Length of handpiece cord.....	Varies with dental unit.
Length of handpiece with P-10 or equivalent tip.....	6.75"
Weight of handpiece, cord, and scaler tip.....	6 oz
Length of foot pedal cord.....	Varies with dental unit.
Non-skid bottom surface on foot pedal.....	N/A
Electrical specifications.....	N/A
Tip stall: side load required.....	> 32 oz

Maximum audible noise at 3" from scaler tip.....	90 dB full power
(Background 36 dB ) .....	92 dB 1/2 power
Maximum audible noise at 12" from scaler tip.....	82 dB full power
(Background 36 dB ) .....	82 dB 1/2 power
Maximum water flow.....	Varies with dental unit.
Pacemaker caution required.....	No

The quality of materials and construction of this scaler are above average. Clarity of maintenance instructions is above average. Reasonability of maintenance requirements and ease of internal access for repair and maintenance is far above average. The manufacturer stresses the need for proper adjustment of the dental unit's water and air pressures before using the scaler. A 4-way gauge is available (Part #411 8731/\$146.25) for these adjustments. The manufacturer has offered to provide the gauges on a temporary loan basis to purchasers from government agencies.

The following advantages/disadvantages are based on user comments and technical evaluators' findings.

### Advantages

- Convenient to have a scaler "at the ready" like a dental handpiece.
- Economical screw-in tips.
- Tips good for subgingival use (but not offset for posterior use).
- Uses dental unit foot pedal for on-off control.

### Disadvantages

- Depends on the availability of a handpiece station at the dental unit.
- Requires careful adjustment of dental unit water and air pressures.

### Recommendation

Overall, through in-house as well as field testing and evaluation, this scaler is rated between above average and far above average. The Kavo America SONICflex 2000 is therefore rated "recommended" for Department of Defense use.

## PART III CONCLUSIONS

### Scaler Market is a Crowded Market

There have been numerous scalers and scaler manufacturers since the Cavitron Corporation first introduced the ultrasonic scaler in 1952. Some of them seem to quickly come and go in today's fast-moving dental market. When we began the literature search for this study in March 1987, there were at least 31 scalers being marketed by 19 or more companies, and although only 14 were submitted by their manufacturers for evaluation, we feel we had the opportunity to test a good sampling of the various types.

## Truth in Advertising

Generally the scalers performed as their manufacturers promised. There seem to be few advertising misstatements. The ultrasonic scalers, when viewed under a stereo microscope, do indeed produce a cavitation effect. It can be seen in the formation of bubbles. Whether or not this bubbling action is, in fact, an advantage in scaling teeth remains to be proven and should be the object of further study.

The piezoelectric ultrasonic scalers provide an environment that is virtually free of electromagnetic interference. This feature makes them safe for use on patients wearing cardiac pacemakers. These scalers have screw-in tips rather than slide-in inserts. Some evaluators liked the screw-in style; others preferred the Cavitron-style inserts. Each has its own advantages and disadvantages.

The sonic scalers are much improved, according to users who have had previous experience with them. Although they seem to provide slightly decreased calculus removal capability as compared to the ultrasonics, they enjoy the advantage of being considerably less expensive and lighter than other power scalers...and more convenient to use. A possible disadvantage of this style of scaler is its dependence on a properly adjusted dental unit for water and power. If all your handpiece stations are occupied by handpieces, you'll need to decide which is most needed--the handpiece or the scaler.

## Mechanical Difficulties

Several of the scalers developed mechanical difficulties during use. Buyers should consider this when making purchasing decisions. Although those breakdowns were generally minor, they were, nonetheless, a source of irritation for the field evaluators. The breakdowns may or may not indicate those scalers' reliabilities. As mentioned before, we did not attempt to measure longevity in this study.

Several of the scalers arrived either without installation and operating instructions, or with only minimal instructions. This can be a problem, especially if the unit doesn't work the first time it's plugged in. In our estimation, installation, operating, and especially troubleshooting instructions are a very important part of the power scaler package.

## Scaler Use On Patients Wearing Cardiac Pacemakers

As discussed previously, the potential for interference with cardiac pacemakers exists when using magnetostrictive ultrasonic scalers. While the likelihood of a problem is very low, it still exists. Therefore, it is recommended that *magnetostrictive* ultrasonic scalers not be used on pacemaker wearers. One alternative is to use a piezoelectric ultrasonic, or a sonic scaler on that infrequent pacemaker wearer. Of course, hand scaling in such cases is another alternative.

## Recommendations Explained

As discussed in the methods and materials section, we rated the scalers "Recommended," meaning the scaler functioned very well in all critical aspects; "Acceptable," meaning the unit was average, neither highly touted nor found to be unacceptable by evaluators; "Not recommended," that is, rated below average overall but not a safety hazard to use; and "Unacceptable," meaning the unit was a safety hazard or of such low quality as to be of no value to military facilities. The recommendations for each of the units are listed as the last comment of each scalers' description found in Part II-B.

## Overall Findings

Overall, only the Simplified Systems Sonatron S3M is rated "not recommended" for Department of Defense (DOD) use. That model arrived without any instructions, and the manufacturer did not provide instructions when contacted. In addition, at one field test site the scaler could not be made to work at all. The S3M should not be confused with another unit made by this company, the Sonatron S3X. The S3X is rated "acceptable" for DOD use.

None of the models tested was rated "unacceptable."

All other power scalers covered by this report generally did what their manufacturers claimed they would do and are either rated "acceptable" or "recommended" for DOD use.

## REFERENCES

1. Ultrasonic carving machine. *Life* 11: 97-100 (1952).
2. Balamuth, L., The application of ultrasonic energy in the dental field, ch. 10, pp. 194-205. In B. Brown, and D. Gordon (eds.). *Ultrasonic technologies in biology and medicine*. London: Life Books Ltd., 1967.
3. Stamps, J., and Muth, E., Reducing accidents and injuries in the dental environment. *Dent Clin of North Am* 22 (3):389-401 (1978).
4. Walmsley, A., Potential hazards of the dental ultrasonic descaler. *Ultrasound Med Biol* 14 (1): 15-20 (1988).
5. Scherman, B., and de Wet, F., Dental treatment of individuals with cardiac pacemakers. *J Dent Assoc S Afr* 34 (9):533-535 (1979).
6. Adams, D., et al. The cardiac pacemaker and ultrasonic scalers. *Dental Health* 22 (1):6-8 (1983).
7. Luker, J., The pacemaker patient in the dental surgery. *Dent* 10 (4):326-332 (1982).
8. Loos, B., et al. An evaluation of basic periodontal therapy using sonic and ultrasonic scalers. *J Clin Periodontol* 14:29-33 (1987).
9. Lie, T., and Leknes, K., Evaluation of the effect on root surfaces of air turbine scalers and ultrasonic instrumentation. *J Periodontol* 56 (9):522-531 (1985).
10. Checchi, L., and Pelliccioni, G. Hand versus ultrasonic instrumentation in the removal of endotoxins from root surfaces in vitro. *J Periodontol* 59 (6):398-402 (1987).
11. Gellin, R., et al. The effectiveness of the Titan-S sonic scaler versus curettes in the removal of subgingival calculus. *J Periodontol* 59 (11):672-680 (1986).
12. Breininger, D., et al. Comparative effectiveness of ultrasonic and hand scaling for the removal of subgingival plaque and calculus. *J Periodontol* 58 (1):9-18 (1987).

13. Leon, L., and Vogel, R., A comparison of the effectiveness of hand scaling and ultrasonic debridement in furcations as evaluated by differential dark-field microscopy. J Periodontol 58 (2):86-94 (1987).
14. Hamada, N., et al. Clinical evaluation of Odontoson 4N Special. (Abstract) (1986)
15. Rosling, B., et al. Topical antimicrobial therapy and diagnosis of subgingival bacteria in the management of inflammatory periodontal disease. J Clin Periodontol 13:975-981 (1986).
16. Gankerseer, E., and Walmsley, A., Preliminary investigation into the performance of a sonic scaler. J Periodontol 58 (11):780-784 (1987).
17. Christensen, G., Sonic and ultrasonic scalers; Clinical Research Associates (CRA) Newsletter, p 1, Jul 1982.
18. Park, P., Effects of sound on dentists. Dent Clin North Am 22 (3):415-429 (1978).



APPENDIX A: SYNOPSIS OF DENTAL POWER SCALERS

# SYNOPSIS OF DENTAL POWER SCALERS

(Page 1 of 2 pages)

MFG. NAME/ PHONE	ADDRESS	MODEL NAME	SCALER TYPE	SCALER TIPS NUMBER PRO- VIDED	STERILIZABLE? HAND- PIECE INSERTS	PACE- MAKER SAFE?	GOV'T COST UNIT <sup>5</sup>	EXTRA TIPS <sup>3</sup>	GSA CONTRACT NUMBER
Crestson Ind. Inc. 1 800 821 3320	P.O. Box 441, 717 8th St Baldwin City, KS 66006	AG-1050	Ultrasonic (magnetostrictive)	2 Cavitron- style Insert <sup>1</sup>	No	No	\$595.	\$40.	None
Dea-Tal-Pz Inc. (215) 666 9050	P.O. Box 896 Valley Forge, PA 19482	Star Titaa S	Sonic	3 Screw-in	Yes <sup>4</sup>	Yes	\$445 <sup>5</sup>	\$24	V797P3347h 31 Mar 90
Dentaply Int. Inc. (703) 971 6100	P.O. Box 872 York, PA 17405	Cavitron 3000	Ultrasonic (magnetostrictive)	3 Cavitron-2 style Insert	No	No	\$907	\$45	V797P3283h 31 Mar 90
Engler Eng. Corp. (305) 688 8381	1099 E. 47th St Hialeah, FL 33013	Sonax V	Ultrasonic (magnetostrictive)	5 Screw-in	No	No	\$990 <sup>7</sup>	\$23	None
" " " "	" " " "	Ultrasoa 990	Ultrasonic (magnetostrictive)	4 Screw-in	No	No	\$790 <sup>8</sup>	\$23	None
Health Sci. Prod. (800) 237 5794	2429 26th St North Birmingham, AL 35234	HSP Ultrasonic	Ultrasonic (piezoelectric)	4 Screw-in	No	Yes	\$498	\$24	V797P3360h 31 Mar 90
Kavo America (404) 394 9395	5398 Northchester Ct Atlanta, GA 30338	SONICflex 2000	Sonic	3 Screw-in	No	Yes	\$590	\$33	V797P3405h 31 Mar 90
Parkeil (800) 243 7446	P.O. Box 5 Farmingdale, NY 11735	Le Clean Machine	Ultrasonic (magnetostrictive)	0 <sup>1</sup> Cavitron-1 style Insert	Yes	Yes	\$395	\$45 <sup>1</sup>	None
Satalec (201) 882 1799	150 Dwight Place Fairfield, NJ 07006	SP-Quack	Ultrasonic (piezoelectric)	4 Screw-in	No	Yes	\$589	Price Not Available	None
Simplified Sys. Inc. (800) 888 0900	4014 Chase Ave Suite P11 Miami Beach, FL 33140	Sonastros S3M	Ultrasonic (magnetostrictive)	3 Cavitron-3 style Insert	No	No	\$595	\$45	None
" " " "	" " " "	Sonastros S3X	Ultrasonic (magnetostrictive)	3 Cavitron-3 style Insert	No	No	\$595	\$45	None
Spartan USA (800) 325 9027	1725 Larkin Williams Rd Fenton, MO 63026	The Pierce Electric Model S-3	Ultrasonic (piezoelectric)	3 Screw-in	No	No	\$747 <sup>9</sup>	\$23	None
Young Dent. Mfg. (800) 325 1881	2418 Northline Ind. Blvd Maryland Heights, MD 63045	Ultra-Scaler 3100	Ultrasonic (piezoelectric)	3 Screw-in	No	Yes	\$717 <sup>9</sup>	\$50/3 <sup>10</sup>	None
" " " "	" " " "	Ultra-Scaler 3200	Ultrasonic (piezoelectric)	3 Screw-in	Yes	No	\$792 <sup>9</sup>	\$50/3 <sup>10</sup>	None

1 Unit uses Cavitron Model 2002. "TFI" inserts (tips).  
 2 Unit uses Cavitron Model 3000. "90K" inserts (tips) only.  
 3 Unit uses Cavitron Model 2002 and earlier models "TFI" and "P" inserts (tips).  
 4 Autoclave only - not approved for chemical sterilization.  
 5 Prices current as of 1 Jan 89.  
 6 Price includes simulator gauge to ensure unit pressures are correct.  
 Price is \$424 without gauge.  
 7 Discounts for multiple units purchased: 6-11 units, \$792. ea.; 12 or more units, \$743. ea.  
 8 Discounts for multiple units purchased: 6-11 units, \$632. ea.; 12 or more units, \$593. ea.  
 9 Additional discounts may apply depending on volume and length of contract.  
 10 Price for 3-up package (Tipe #1, #4, & #7)

## SYNOPSIS OF DENTAL POWER SCALERS

(Page 2 of 2 pages)

MODEL NAME	POWER UNIT		HANDPIECE		CORD LENGTHS		POWER CONTROL BY:	PLUMBING	UTILITY REQUIREMENTS		COMPRESSED AIR
	WEIGHT (LBS)	DIMENSIONS (IN INCHES)	SIZE	WEIGHT (INCLUDES CORD)	FOOT PEDAL	HAND-PIECE			QUICK H <sub>2</sub> O CONNECT SUPPLIED?	ELECTRICAL	
AG-1050	5.5	3.7H x 8.5W x 10.5D	9.6"	5oz	82"	114"	Foot pedal provided	Water supply	Yes <sup>1,2</sup>	None	None
Star Titan S	N/A	N/A	6.75"	Handpiece only (1.8oz)	N/A <sup>11</sup>	N/A <sup>11</sup>	Dental unit foot pedal	H <sub>2</sub> O 15 psi (from handpiece hose)	N/A	None	40 psi
Cavitron 3000	4.75	9H x 13W x 15.5D	8"	5oz	94"	80"	Foot pedal provided	H <sub>2</sub> O 25-60 psi	No	Yes <sup>1,2</sup>	None
Sonax V	6.3	3.4H x 8.5W x 10.5D	8.6"	5oz	77"	97"	Foot pedal provided	H <sub>2</sub> O 30-60 psi	Yes	Yes <sup>1,2</sup>	None
Ultrason 990	6.1	3.25H x 8.9W x 7.25D	8.5"	5oz	76"	93"	Foot pedal provided	H <sub>2</sub> O 30-60 psi	Yes	Yes <sup>1,2</sup>	None
MSP Ultrasonik	2.9	2.6H x 9.8W x 8.6D	6.25"	4oz	97"	75"	Foot pedal provided	H <sub>2</sub> O 10-80 psi	Yes	Yes <sup>1,2</sup>	None
SONICflex 2000	N/A	N/A	6.75"	Handpiece only (2.3oz)	N/A <sup>11</sup>	N/A <sup>11</sup>	Dental unit foot pedal	H <sub>2</sub> O 14-28 psi	N/A	None	36-40 psi
Le Clean Machine	4.25	3.25H x 11.25W x 5.75D	8.25"	4oz	70"	73"	Foot pedal provided	H <sub>2</sub> O 20-50 psi	Yes	Yes <sup>1,2</sup>	None
SP-Quick	0.9	1.9H x 3.7W x 7D	7.5"	5oz	N/A <sup>11</sup>	98"	Dental unit foot pedal	H <sub>2</sub> O 25-100 psi (from handpiece hose)	N/A	Yes <sup>1,2</sup>	30-80 psi
Sonstros S3M	1.6	2.9H x 8.25W x 7.5D	9"	5.5oz	N/A <sup>11</sup>	95"	Dental unit foot pedal	H <sub>2</sub> O 21-60psi	N/A	Yes <sup>1,2</sup>	None
Sonstros S3X	2.4	2.9H x 8.9W x 7.5D	9.75"	4.5oz	97"	94"	Foot pedal provided	H <sub>2</sub> O 20-60psi	Yes	Yes <sup>1,2</sup>	None
The Piezo-Electric	2.6	2.8H x 9W x 7.2D	6.75"	4oz	76"	73"	Foot pedal provided	Standard H <sub>2</sub> O	Yes	Yes <sup>1,2</sup>	None
Ultra-Scaler 3100	2.9	2.8H x 9.3W x 7.5D	6.75"	4oz	95"	73"	Foot pedal provided	H <sub>2</sub> O max 40 psi	Yes	Yes <sup>1,2</sup>	None
Ultra-Scaler 3200	2.9	2.8H x 9.3W x 7.5D	6.75"	6oz	95"	77"	Foot pedal provided	H <sub>2</sub> O max 40 psi	Yes	Yes <sup>1,2</sup>	None

<sup>11</sup> Scaler uses dental unit foot pedal and/or handpiece cord.

<sup>12</sup> All units tested are available in 110, 220 VAC and 50, 60 Hz.

Be sure to state your voltage/hertz requirements when ordering.

APPENDIX B: SCALER EVALUATION SCORE SHEET

## SCALER EVALUATION SCORE SHEET

The following items should be rated according to the scale of 1 to 5 as shown below. Fill out this evaluation immediately after completing the week's user test on each unit and return it in the preaddressed envelopes. This will allow for statistical manipulation of the results into meaningful data. Comments are encouraged after each line item.

### RATING SCALE:

- 1 - Outstanding
- 2 - Superior
- 3 - Average
- 4 - Inferior
- 5 - Unacceptable

\_\_\_\_\_  
Unit evaluated/date

\_\_\_\_\_  
Facility where evaluation occurred

\_\_\_\_\_  
Name of evaluator

### A. DESIGN AND QUALITY OF CONSTRUCTION

(Rating)

- \_\_\_\_ 1. Complete and clear operating instructions.
- \_\_\_\_ 2. Complete and clear user maintenance instructions.
- \_\_\_\_ 3. Ease of required user maintenance.
- \_\_\_\_ 4. Little user maintenance required.
- \_\_\_\_ 5. Foot control ease of operation.
- \_\_\_\_ 6. Ease of power adjustments.
- \_\_\_\_ 7. Ease of adjustment and control of water spray.
- \_\_\_\_ 8. Ease of tuning.
- \_\_\_\_ 9. Low noise level during use.
- \_\_\_\_ 10. Low weight and easy to move to different locations.
- \_\_\_\_ 11. Easy to wipe the outside of the unit.

### B. HOSE AND HANDPIECE

(Rating)

- \_\_\_\_ 12. Easy to clean and disinfect the handpiece.
- \_\_\_\_ 13. Easy to clean and disinfect hose.
- \_\_\_\_ 14. Handpiece hoses are easy to use (long, flexible, etc.)
- \_\_\_\_ 15. Handpiece holders adequate and conveniently placed.
- \_\_\_\_ 16. Ease of disconnecting handpiece hose to unit.

### C. TIPS

(Rating)

- \_\_\_\_ 17. Does it remove calculus well during use?
- \_\_\_\_ 18. Are tips available to do the job?
- \_\_\_\_ 19. Are tips easy to sterilize?
- \_\_\_\_ 20. Is pattern of water spray adequate?
- \_\_\_\_ 21. Are tips changed quickly and easily?
- \_\_\_\_ 22. Did tips perform well even with repeated heat sterilization?

### D. OVERALL EFFECTIVENESS

(Rating)

- \_\_\_\_ 23. Does not craze, score, or wear away enamel and/or cementum during use.
- \_\_\_\_ 24. Does not cause unusual soft tissue trauma or irritation during use.
- \_\_\_\_ 25. Does not cause tooth sensitivity during use.
- \_\_\_\_ 26. Does not cause tooth sensitivity following use.
- \_\_\_\_ 27. How well did the unit operate?
- \_\_\_\_ 28. Were you pleased with the unit?

### E. ADDITIONAL COMMENTS:

APPENDIX C: CLINICAL EVALUATIONS RAW DATA

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE					
		Raters	Design and Quality of Construction A.										Hose & B. Handpiece B.					C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		24	25	26	27	28
Y O L U T N R G A S P C I A L E Z E R	US Air Force																														
	1 Periodontist	30	2	2	1	1	1	2	2	1	3	2	1	1	1	2	3	U	2	4	1	2	1	1	2	2	1	1	2	2	1.6
	2 Hygienist	32	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	3	1	2	2	2	2	1	1	1.3
	3 Technician	30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	U	2	2	2	2	1	2	2	2	2	3	2	2	2.0
	US Army		DID NOT EVALUATE																												
	4 Periodontist		DID NOT EVALUATE																												
	5 Hygienist		1	1	1	1	5	U	U	U	U	1	1	1	U	1	1	1	U	3	1	U	2	U	UNIT DEVELOPED POWER SHORT USER COULD NOT EVALUATE						
	6 Hygienist	05	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0
	7 Hygienist		DID NOT EVALUATE																												
	8 Hygienist		DID NOT EVALUATE																												
	9 Hygienist		3	3	3	3	U	U	U	U	U	3	3	3	3	3	3	3	U	U	3	U	U	U	UNIT DEVELOPED POWER SHORT USER COULD NOT EVALUATE						
	US Navy																														
10 Periodontist	16	2	2	2	1	3	2	4	2	1	1	1	1	1	1	1	1	2	2	3	4	3	1	3	2	2	2	3	3	2.0	
11 Hygienist	17	3	U	3	2	4	4	4	4	2	2	2	2	U	2	3	U	3	4	3	3	3	3	3	4	4	U	4	4	3.1	
12 Technician	22	3	3	3	3	5	3	3	3	2	3	3	3	3	3	3	3	3	3	2	5	5	4	3	3	3	3	4	4	2.5	
<b>TOTAL PATIENTS</b>		152	U = Not reported from the clinical test site.																								RANGE: 1.3-2.5	AVERAGE: 2.1			

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE					
		Raters	Design and Quality of Construction A.										Hose & B. Handpiece B.					C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		24	25	26	27	28
Y O L U T N R G A S P C I A L E Z E R	US Air Force																														
	1 Periodontist	30	1	1	2	1	1	2	1	1	2	2	1	1	1	1	2	U	2	2	1	1	1	1	1	1	2	1	1	1	1.2
	2 Hygienist	32	2	2	2	2	2	2	2	2	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2.5
	3 Technician	29	2	2	2	2	2	3	3	3	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2	3	3	3	4	2.4
	US Army		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	4 Periodontist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	5 Hygienist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	6 Hygienist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	7 Hygienist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	8 Hygienist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	9 Hygienist		NOT EVALUATED DUE TO MECHANICAL DIFFICULTIES																												
	US Navy																														
10 Periodontist	14	2	2	3	2	4	4	4	3	1	1	2	2	2	2	2	2	3	3	2	3	3	2	2	2	4	3	3	3	2.4	
11 Hygienist	10	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.0	
12 Technician	27	3	3	3	3	4	3	3	3	3	2	2	2	3	3	3	4	3	3	3	3	3	3	3	3	3	4	4	3.4		
<b>TOTAL PATIENTS</b>		142	U = Not reported from the clinical test site.																								RANGE: 1.2-3.4	AVERAGE: 2.5			

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME		NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE				
			Design and Quality of Construction A.											Hose & B. Handpiece				C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28
SIMPLIFIED SYX	US Air Force																														
	1 Periodontist	20	2	2	3	2	3	2	2	2	3	3	3	2	2	1	2	3	2	2	2	2	3	2	2	3	3	3	2	3	2.4
	2 Hygienist	32	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	3	3	5	3	3	3	3	3	3	3	3	3	3	2.9
	3 Technician	30	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	3	2	2	2	2	2	2	3	3	2	2	2.2	
	US Army																														
	4 Periodontist	03	2	1	1	1	3	3	3	3	3	1	1	1	1	1	1	3	2	4	1	3	2	2	3	3	4	4	2	2	2.3
	5 Hygienist	04	1	1	1	1	1	1	1	1	1	1	1	1	U	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0
	6 Hygienist	05	2	2	2	2	2	2	2	2	3	3	3	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2.2
	7 Hygienist	25	2	2	2	2	2	3	3	3	3	2	2	3	3	3	3	3	3	3	2	3	2	2	3	3	2	3	3	3	2.6
	8 Hygienist	05	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.1
	9 Hygienist		NOT EVALUATED DUE TO SIZE OF POWER PACK. WOULD NOT FIT MINIMUM ACCESS WALL RECEPTACLE.																												
	US Navy																														
10 Periodontist	12	1	1	2	2	2	1	3	2	4	1	1	1	1	1	2	1	1	1	1	3	1	2	1	2	1	1	2	2	1.6	
11 Hygienist	30	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.0	
12 Technician	21	2	2	1	1	1	1	1	2	2	1	1	1	1	1	U	2	1	1	1	1	1	2	2	1	1	2	2	1.3		
TOTAL PATIENTS		187	U = Not reported from the clinical test site.											RANGE: 1.0-3.1				AVERAGE: 2.2													

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME		NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE				
			Design and Quality of Construction A.											Hose & B. Handpiece				C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28
HEALTH PRODUCTS SCIENCE	US Air Force																														
	1 Periodontist	30	2	2	1	1	1	1	1	1	2	1	1	1	1	2	U	1	2	1	1	1	1	1	1	1	1	1	1	1.2	
	2 Hygienist	35	U	U	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3	3	3	2	2	2.2	
	3 Technician	30	2	2	2	2	2	2	2	2	3	2	2	2	2	2	U	2	2	2	2	2	2	3	2	2	2	2	2	2.1	
	US Army																														
	4 Periodontist		NOT EVALUATED																												
	5 Hygienist	1.5	1	1	3	3	3	2	2	2	4	3	1	1	U	1	2	2	4	4	3	3	4	5	3	5	5	3	5	5	2.9
	6 Hygienist		NOT EVALUATED																												
	7 Hygienist	06	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	4	3	3	4	3	3	3	3	3.0	
	8 Hygienist	05	3	3	4	4	3	3	3	3	4	3	3	3	3	3	3	3	5	5	3	3	5	4	3	5	3	3	5	5	3.6
	9 Hygienist	09	3	3	3	2	3	3	3	3	2	2	2	2	U	3	3	3	4	5	3	3	3	5	3	5	5	3	5	5	3.3
	US Navy																														
10 Periodontist	16	2	2	2	2	3	4	2	3	1	1	1	2	2	2	2	2	4	3	2	2	3	3	2	2	2	2	3	3	2.3	
11 Hygienist	12	3	4	3	3	2	1	1	1	3	3	3	3	3	3	3	3	1	2	2	1	3	3	3	3	3	3	1	1	2.4	
12 Technician	24	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3	2	3	3	2	2	3	3	2	2	2.8	
TOTAL PATIENTS		188.5	U = Not reported from the clinical test site.											RANGE: 1.2-3.6				AVERAGE: 2.6													



TRISERVICE SCALER STUDY																															
SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION																															
SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE				
		Raters	Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28
S A P T E L E I C K	US Air Force	01	3	3	2	2	U	U	5	5	U	U	2	5	5	5	5	5	U	U	U	U	U	U	5	5	5	5	5	5	4.3
	1 Periodontist	15	2	2	3	3	3	1	1	1	3	4	1	1	1	1	1	1	3	2	1	3	3	1	3	3	3	3	4	4	2.2
	2 Hygienist	10	3	3	4	U	2	2	3	U	2	2	2	2	2	3	3	3	2	2	2	2	2	2	2	2	2	2	4	4	2.5
	3 Technician	NO RESPONSE																													
	US Army	03	3	1	2	2	2	1	1	1	4	1	1	3	3	2	2	2	1	5	1	1	4	1	4	1	4	U	1	1	2.0
	4 Periodontist	NO RESPONSE																													
	5 Hygienist	02	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0
	6 Hygienist	03	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3.0
	7 Hygienist	03	3	3	3	3	3	3	3	3	4	3	3	3	3	4	5	4	4	4	3	3	4	3	4	4	3	3	4	4	3.4
	8 Hygienist	NO TEST DUE TO TECHNICAL PROBLEMS IN DENTAL OPERATORY																													
	9 Hygienist	NO TEST DUE TO TECHNICAL PROBLEMS IN DENTAL OPERATORY																													
	US Navy	22	1	1	1	1	2	3	3	3	1	1	1	1	2	1	1	1	2	1	1	2	3	1	1	1	2	1	2	1	1.5
10 Periodontist	24	1	3	3	3	1	2	2	2	3	1	1	1	3	4	3	3	2	2	1	2	3	3	2	2	3	3	2	2	2.3	
11 Hygienist	18	2	2	2	2	1	1	2	1	3	3	1	1	1	3	2	2	2	3	2	2	3	2	2	2	2	2	3	3	2.0	
12 Technician	TOTAL PATIENTS 102																														
U = Not reported from the clinical test site. RANGE: 1.5-4.3 AVERAGE: 2.6																															

TRISERVICE SCALER STUDY																															
SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION																															
SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE				
		Raters	Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips				Overall D. Effectiveness									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28
P I E S Z P O A R E L A E N C T R I C	US Air Force	28	1	2	1	1	1	2	1	1	2	2	1	1	1	2	2	U	2	2	1	1	1	1	2	1	1	1	2	1	1.4
	1 Periodontist	40	2	2	1	1	1	1	1	1	3	1	1	1	1	1	1	3	3	3	1	2	2	2	2	4	4	3	4	4	2.0
	2 Hygienist	28	2	2	2	2	2	2	2	2	3	2	2	2	2	2	U	2	2	2	2	2	U	2	2	2	2	2	2	2.0	
	3 Technician	NO RESPONSE																													
	US Army	05	3	3	2	1	3	2	2	2	4	2	3	3	3	3	3	3	2	3	3	3	5	3	3	3	3	3	3	3	2.8
	4 Periodontist	05	1	1	1	1	4	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.1
	5 Hygienist	03	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	3	2	3	3	3	3	2.2
	6 Hygienist	06	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	3	3	3	4	3.1
	7 Hygienist	05	3	3	3	3	3	3	3	3	5	3	3	3	3	3	3	3	3	5	3	3	5	3	3	5	3	3	3	5	3.4
	8 Hygienist	05	3	3	3	3	3	3	3	3	3	2	3	3	U	3	3	3	3	4	3	3	3	3	3	4	4	3	3	3	3.0
	9 Hygienist	NO TEST DUE TO TECHNICAL PROBLEMS IN DENTAL OPERATORY																													
	US Navy	22	2	1	1	1	1	2	3	3	1	1	2	2	2	1	2	2	3	2	2	2	3	1	2	2	2	3	2	2	1.9
10 Periodontist	17	3	3	3	3	2	2	3	3	3	2	2	3	3	2	3	3	2	3	3	3	4	3	3	3	3	3	2	2	2.8	
11 Hygienist	21	2	2	2	2	2	3	3	3	2	3	2	2	2	3	3	2	3	4	2	2	4	2	3	3	2	2	4	4	2.7	
12 Technician	TOTAL PATIENTS 185																														
U = Not reported from the clinical test site. RANGE: 1.1-3.4 AVERAGE: 2.4																															

TRISERVICE SCALER STUDY																												
SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION																												
SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE		
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26
PARKLEANN MACHINE	US Air Force																											
	1 Periodontist	28	2	2	2	1	1	1	1	1	2	3	1	1	1	2	2	1										
	2 Hygienist	20	2	2	2	2	2	3	3	3	3	2	2	2	2	2	2	2										
	3 Technician	30	3	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3										
	US Army		Not Evaluated											TIPS NOT PROVIDED WITH SCALER														
	4 Periodontist		Not Evaluated											TIPS NOT PROVIDED WITH SCALER														
	5 Hygienist		Not Evaluated											TIPS NOT PROVIDED WITH SCALER														
	6 Hygienist	04	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2										
	7 Hygienist	02	3	3	3	3	4	3	3	3	3	3	3	3	3	3	5	3										
	8 Hygienist	05	3	3	3	3	4	3	3	3	3	3	3	3	3	4	3	3										
	9 Hygienist	05	3	3	3	2	4	3	3	3	5	2	3	3	U	3	5	3										
	US Navy																											
10 Periodontist	12	2	2	2	2	4	1	2	2	2	2	1	2	2	2	2	2											
11 Hygienist	22	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3											
12 Technician	27	3	3	3	3	5	3	3	3	3	3	2	2	2	4	3	3											
TOTAL PATIENTS		155	U = Not reported from the clinical test site.																								RANGE: 1.6-3.3	AVERAGE: 2.7

TRISERVICE SCALER STUDY																													
SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION																													
SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE			
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27
SIMPLIFIED SYSTEMS	US Air Force		INTERNAL WATER LEAK PREVENTED TESTING																										
	1 Periodontist		INTERNAL WATER LEAK PREVENTED TESTING																										
	2 Hygienist		INTERNAL WATER LEAK PREVENTED TESTING																										
	3 Technician		INTERNAL WATER LEAK PREVENTED TESTING																										
	US Army																												
	4 Periodontist	03	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	4	3	3	3	5	3	3	3	3	2	4
	5 Hygienist		NOT EVALUATED																										
	6 Hygienist	03	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	3
	7 Hygienist	16	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
	8 Hygienist	03	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	9 Hygienist		UNABLE TO EVAL. POWER PACK WOULD NOT FIT WALL PLUG DUE TO SPACE LIMITATIONS.																										
	US Navy																												
10 Periodontist	12	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2
11 Hygienist	28	2	2	3	U	2	3	3	3	2	2	2	2	U	1	3	2	3	2	2	3	2	U	3	3	3	2	3	3
12 Technician	24	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	2	2	2	2	1	2	3	3	3	3	2	1	
TOTAL PATIENTS		89	U = Not reported from the clinical test site.																								RANGE: 2.1-3.1	AVERAGE: 2.6	

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE					
		Design and Quality of Construction										A.					Hose & B. Handpiece					C. Tips					Overall D. Effectiveness				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28	
ENGLERS V	US Air Force																														
	1 Periodontist	30	2	2	2	2	2	2	1	1	3	2	2	2	2	3	2	U	3	3	1	2	3	2	2	2	2	2	2	2	1.9
	2 Hygienist	24	3	3	3	3	2	2	2	2	3	2	2	3	3	3	3	3	2	1	3	3	3	3	2	2	2	2	2	2	2.5
	3 Technician	31	2	2	2	2	2	2	2	2	4	2	2	2	3	2	2	U	2	2	2	2	2	2	2	2	2	3	2	2	2.1
	US Army																														
	4 Periodontist	04	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	3	2.8
	5 Hygienist	01	1	1	1	1	1	1	1	1	1	1	1	1	U	1	1	1	4	3	1	1	4	5	3	5	3	1	3	5	1.9
	6 Hygienist	03	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.1
	7 Hygienist	02	3	3	3	3	2	2	3	2	2	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	4	3	4	4	3.0
	8 Hygienist	02	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3	5	3	3	5	3	3	5	5	3.4
	9 Hygienist	02	3	3	3	3	3	3	3	3	3	2	2	U	U	3	3	4	5	5	4	3	5	5	3	5	5	3	5	5	3.6
	US Navy																														
10 Periodontist	19	1	1	1	1	1	2	2	1	2	2	1	2	2	1	1	2	2	2	1	1	3	2	2	2	1	1	1	1	1.5	
11 Hygienist	12	4	3	3	U	2	3	3	4	3	3	3	4	3	2	3	U	3	3	2	4	4	3	3	3	3	3	4	4	3.2	
12 Technician	33	2	2	1	2	2	1	1	1	2	3	1	1	1	1	1	U	1	3	1	1	1	1	1	1	1	2	2	2	1.4	
TOTAL PATIENTS		163	U = Not reported from the clinical test site.																		RANGE: 1.4-3.6				AVERAGE: 2.5						

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																								AVERAGE SCORE															
		Design and Quality of Construction										A.					Hose & B. Handpiece					C. Tips					Overall D. Effectiveness														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		25	26	27	28											
ENGLERSON 990	US Air Force																																								
	1 Periodontist	30	2	2	1	1	1	1	1	2	2	1	1	1	1	3	U	1	1	1	1	1	1	1	1	2	2	1	1	1.3											
	2 Hygienist	48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0											
	3 Technician	35	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0											
	US Army																																								
	4 Periodontist		DID NOT EVALUATE																																						
	5 Hygienist	05	1	1	1	1	5	1	1	1	1	1	1	U	1	1	U	1	1	1	1	4	1	1	1	1	1	1	3	1.4											
	6 Hygienist		DID NOT EVALUATE																																						
	7 Hygienist		DID NOT EVALUATE																																						
	8 Hygienist	05	3	3	3	3	3	5	5	5	3	3	3	3	3	3	3	5	5	3	5	5	3	3	4	3	3	5	5	3.7											
	9 Hygienist	00	3	3	3	3	3	3	3	1	3	3	3	U	3	3	3	WATER LEAK PRECLUDED FURTHER EVAL																							
	US Navy																																								
10 Periodontist	13	3	2	2	2	3	3	3	1	1	2	2	2	2	3	2	3	4	2	2	2	4	3	2	4	2	3	2	2	2.4											
11 Hygienist	12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	4	2	2	4	3	3	3	3	3	3	3	3.0												
12 Technician	22	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	2	3	3	3	3.0												
TOTAL PATIENTS		170	U = Not reported from the clinical test site.																		RANGE: 1.0-3.7				AVERAGE: 2.2																

### TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE				
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		26	27	28	
DENTALTALSONSNIAC	US Air Force																														
	1 Periodontist	17	1	1	1	1	U	U	1	U	3	2	1	1	1	2	2	2	2	2	1	1	2	1	2	1	1	2	1	1	1.4
	2 Hygienist	35	2	2	1	1	2	1	1	1	3	1	1	1	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.3
	3 Technician	32	1	1	1	1	1	1	1	1	3	2	2	1	U	U	U	1	2	1	1	1	1	1	2	2	2	3	2	2	1.5
	US Army																														
	4 Periodontist	03	1	1	1	1	U	U	U	U	1	1	1	2	2	U	U	3	3	3	1	2	3	2	2	2	2	U	2	2	1.8
	5 Hygienist	00	1	1	1	1	U	U	U	U	1	1	1	1	U	U	U	1	U	1	1	U	1	U	Did not eval as user's unit does not have H2O to high speed handpiece hose.						
	6 Hygienist	03	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2.1
	7 Hygienist	16	3	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	4	4	3	3	3	3	3	3	3.0
	8 Hygienist	04	3	3	3	3	2	2	2	2	2	3	3	3	3	4	3	4	5	3	3	3	2	3	3	3	3	3	4	4	3.0
	9 Hygienist	20	3	3	3	2	2	3	3	3	3	3	2	2	3	U	U	3	4	4	3	3	3	3	2	2	1	2	3	3	2.7
	US Navy																														
10 Periodontist	14	1	1	2	1	1	1	2	2	1	3	2	1	1	1	2	2	3	2	2	1	1	1	1	2	1	1	2	1	1.5	
11 Hygienist	31	2	2	2	2	U	1	U	U	3	1	1	1	3	3	2	3	1	2	2	2	2	3	3	3	3	3	1	1	2.1	
12 Technician	26	3	3	1	2	1	1	1	1	1	2	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1.6	
TOTAL PATIENTS		201	U = Not reported from the clinical test site.																				RANGE: 1.3-3.0	AVERAGE: 2.0							

### TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE				
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		26	27	28	
SKANVIOCFALMEXRICOAO	US Air Force																														
	1 Periodontist	21	4	4	3	3	U	U	2	U	3	1	1	U	U	U	U	1	2	2	1	2	2	2	3	2	3	3	2	3	2.3
	2 Hygienist	33	2	2	2	2	2	2	2	2	2	1	1	1	3	3	3	3	2	2	2	3	2	2	2	2	2	2	2	2	2.1
	3 Technician	33	3	3	2	2	1	3	2	3	2	1	1	1	U	U	1	1	3	3	2	2	2	2	3	2	2	2	2	2	2.0
	US Army																														
	4 Periodontist	04	1	1	3	3	3	1	1	1	1	3	3	3	3	5	2	3	3	2	3	2	4	3	3	2	3	3	3	2	2.5
	5 Hygienist		NOT TESTED																												
	6 Hygienist		NOT TESTED																												
	7 Hygienist		NOT TESTED																												
	8 Hygienist		NOT TESTED																												
	9 Hygienist		NOT TESTED																												
	US Navy																														
10 Periodontist	16	2	1	1	1	1	1	1	2	3	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	1.1	
11 Hygienist	27	2	2	2	2	2	1	1	1	1	1	1	1	3	3	1	1	1	3	1	2	1	2	2	1	2	U	1	1	1.5	
12 Technician	27	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	1	1	2	1	1	1	1	1	1	3	1	1	1.8	
TOTAL PATIENTS		161	U = Not reported from the clinical test site.																				RANGE: 1.1-2.5	AVERAGE: 1.9							

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE								
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		26	27	28					
C R A G N S T O 5 N O	US Air Force																																		
	1 Periodontist	30	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2	3	U	2	3	2	1	3	2	2	3	3	2	2	3	2.1	
	2 Hygienist	32	U	U	3	3	3	3	3	3	2	3	4	2	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.0
	3 Technician	28	2	2	2	2	2	2	2	2	3	3	1	1	1	1	1	1	1	2	2	1	2	1	2	2	3	2	2	2	2.2				
	US Army																																		
	4 Periodontist	02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	5	1	1	1	1	3	4	4	1	1	1	1.5				
	5 Hygienist	01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	3	1	1	1	1	1	1	1	1	3	2	1.3				
	6 Hygienist	01	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0				
	7 Hygienist	05	3	3	3	3	3	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3.1				
	8 Hygienist	02	3	3	3	3	3	3	3	3	3	3	3	3	3	2	5	3	2	5	3	2	3	3	3	3	3	3	2	2	3.0				
	9 Hygienist	02	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	3	2.6				
	US Navy																																		
10 Periodontist	16	2	2	2	2	1	1	1	3	1	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	2	2	1	1	1.6					
11 Hygienist	21	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	4	4	3	3	4	3	3	3	3	4	4	3.2					
12 Technician	24	3	3	3	3	3	3	4	3	3	2	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	4	4	3.1					
TOTAL PATIENTS		164																																	
			U = Not reported from the clinical test site.																																
													RANGE: 1.3-3.2					AVERAGE: 2.4																	

## TRISERVICE SCALER STUDY

SEE APPENDIX B FOR EXPLANATION OF POINTS OF EVALUATION

SCALER NAME	NUMBER OF PATIENTS SEEN	Points of Evaluation																									AVERAGE SCORE				
		Design and Quality of Construction A.										Hose & B. Handpiece					C. Tips					Overall D. Effectiveness									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		26	27	28	
C A D V E I N T R S P N L Y 3 0 0 0	US Air Force																														
	1 Periodontist	25	1	1	2	2	1	1	2	1	3	2	1	2	1	2	1	U	1	1	1	1	3	1	1	2	3	2	1	2	1.6
	2 Hygienist	29	2	2	3	3	2	3	3	3	3	3	3	2	2	2	2	3	2	3	2	2	3	2	3	4	4	4	4	4	2.8
	3 Technician	32	2	2	2	2	2	2	2	2	3	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2	3	3	2	2	2.2
	US Army																														
	4 Periodontist	05	2	1	1	1	3	2	4	1	3	1	1	2	2	1	1	1	1	5	1	3	2	1	3	1	4	2	1	3	1.9
	5 Hygienist	01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0
	6 Hygienist	03	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0
	7 Hygienist	14	3	3	3	3	3	3	3	3	2	1	2	3	3	3	3	3	2	3	3	3	2	2	2	2	2	2	2	2	2.6
	8 Hygienist	05	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2.7
	9 Hygienist	05	U	U	3	3	3	3	3	3	1	3	1	3	U	3	3	3	3	4	3	3	3	3	3	4	3	3	3	3	3.0
	US Navy																														
10 Periodontist	13	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.1	
11 Hygienist	21	2	2	2	2	1	2	2	2	1	1	1	1	2	1	2	3	2	3	3	2	1	2	3	2	3	3	1	1	1.9	
12 Technician	24	3	2	2	2	2	1	3	3	1	1	1	3	3	2	2	1	2	2	2	4	2	2	2	1	2	2	2	12	2.1	
TOTAL PATIENTS		177																													
			U = Not reported from the clinical test site.																												
													RANGE: 1.0-3.0					AVERAGE: 2.1													